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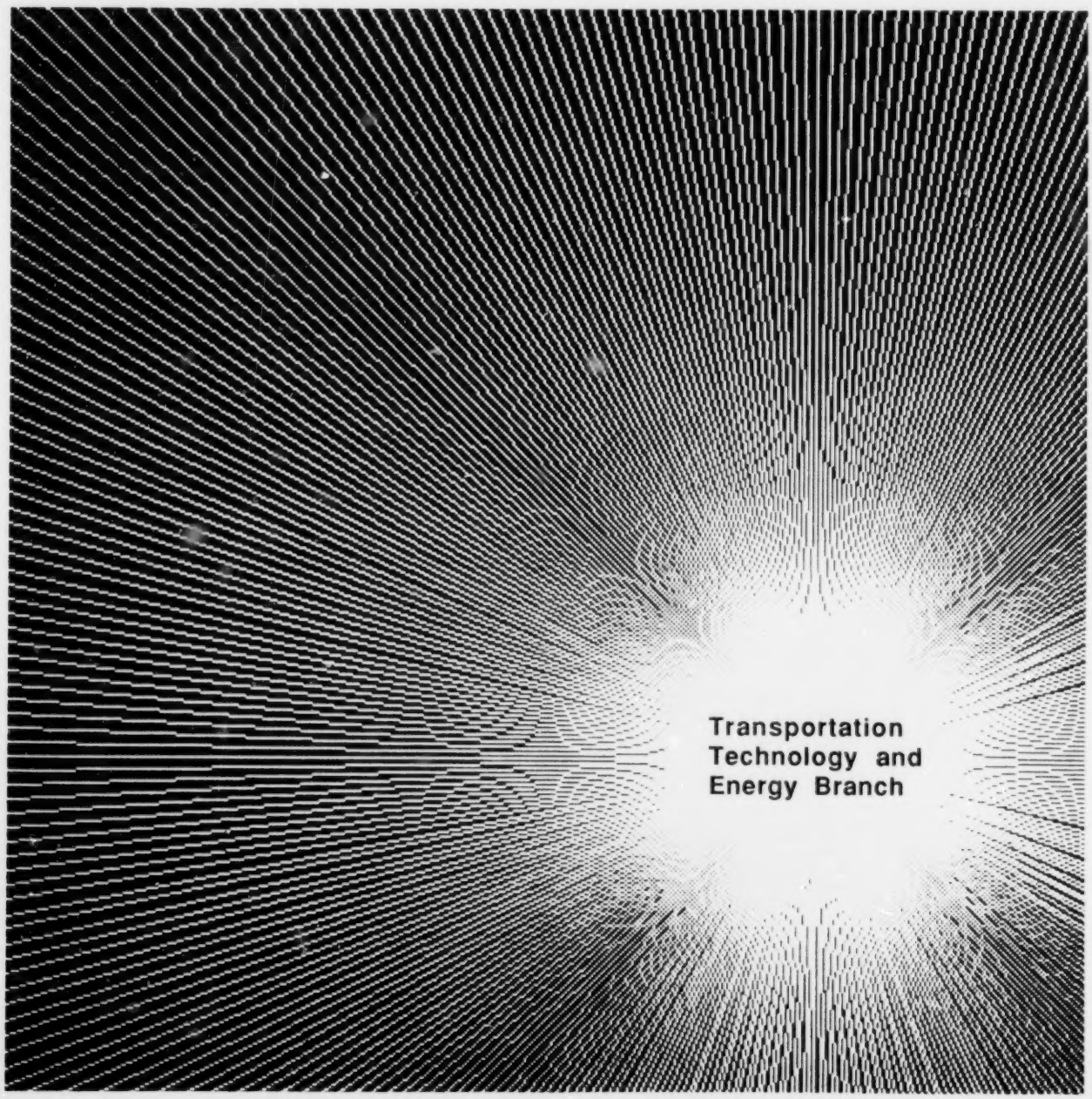

Electric Vans in Courier Service: Second Six-Month Progress Report

EV-88-02

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D. Hsu

J. Duncan
Vehicle Technology Office

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Electric Vans in Courier Service: Second Six-Month Progress Report

Prepared by:	**D. Hsu** Research Engineer **J. Duncan** Head, Electric Vehicles Section

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Abstract:

The Ontario Ministry of Transportation is conducting an over-the-road evaluation of two General Motors Griffon electric vans. The objective of the program is to establish an understanding of the behaviour, reliability, life cycle cost, and operational limitations of electric vehicles in routine urban traffic in Canada.

This report describes the second six-month vehicle operation in courier service. The cumulative twelve-month operational results are given.

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EXECUTIVE SUMMARY

This report summarizes the second six-month operation of EV 11 and EV 12 electric vans in courier service between the Queen's Park complex and the Ministry of Transportation (MTO), in Downsview. The operational statistics for the cumulative twelve-month period from May 14, 1986 to May 13, 1987, are as follows:

- A total driving distance of 39 702 km (24 672 miles) was logged by the two electric vans.
- EV 11 was in full-day service for 176 days out of 249 days.
- EV 12 was in full-day service for 163 days out of 249 days.
- The mean vehicle daily driving distance was 79.72 km (49.54 miles), averaged over 249 days.
- The electricity consumption per unit distance was 0.50 kWh/km (0.81 kWh/mile) and the electricity cost was 1.90 ¢/km (3.08 ¢/mile).
- The operational cost, which includes electricity, heater fuel, battery water, vehicle maintenance parts, and labour, was 10.59 ¢/km (17.03 ¢/mile).

1/ INTRODUCTION

On May 13, 1987 the two Griffon one-tonne electric vans had successfully completed their first year of courier service. The operation of the courier service is provided by the Ontario Government Repair Garage, Engineering Equipment Office of MTO. The Vehicle Technology Office is responsible for the vehicle maintenance, data recording, and data analysis of the operation.

The vans were paid for by the Ministry of Energy under its Alternative Fuel Program. The management of the electric vehicle testing and demonstration program was transferred from the Ontario Centre for Automotive Parts Technology to the Ministry of Transportation on April 1, 1987.

This report summarizes the second six-month and the cumulative one-year operational results of the two electric vans.

2/ OBJECTIVE

The testing and demonstration program is being carried out to establish an understanding of the behaviour, reliability, life-cycle cost, and operational limitations of the two Griffon electric vans as they perform in daily scheduled courier service in Canadian conditions.

3/ VEHICLE CONFIGURATION

There was no modification made to the two Griffon vans during the second six-month period. They are both nine-seat vans with limited cargo space in the rear compartment. Details of both vans are listed in *Electric Vans Progress Report* [1] published in October 1986 and in *Electric Vans In Courier Service: Six-Month Progress Report* [2] published in September 1987.

4/ COURIER SERVICE

The courier service operation is provided and controlled by the Government Repair Garage, Engineering Equipment Office of MTO. The service is a scheduled shuttle run between MTO in Downsview and the Queen's Park Government Repair Garage on Bay Street. It carries passengers, mail, and small parcels related to government business. The actual route between the two points is subject to the operator's choice and the number of stops required for a particular run. In general, operators are advised to avoid the use of freeway sections in order to conserve energy. The time taken for one trip varies from 25 to 45 minutes depending on traffic conditions, number and location of stops, and time spent on picking up and delivering mail and parcels on the route. Figure 1 shows the most popular routes used by the operators during the second six-month period. For further details please refer to *Electric Vans in Courier Service: Six-Month Progress Report* [2].

5/ BATTERY CHARGE

Two Lucas Chloride Spegel Type S1P 108/30 battery chargers are used in this operation. One charger is located in the garage on Bay Street; the other is located in the South Garage, District 42 in the MTO Dowsview complex.

Three battery charge terms are used in this report:
1/ Overnight charge
2/ Trickle charge
3/ Opportunity charge

The overnight charge always takes place at the vehicle depot after the vehicle finishes its last daily run. In general, charging starts at around 4:15 p.m. and ends at midnight.

A trickle charge lasts about fifteen minutes and occurs about five and a half hours after the end of the overnight charge. If the vehicle is left on the charger, the trickle charge will repeat itself every five and a half hours as is the case during weekends and holidays.

An opportunity charge takes place when the vehicle is plugged into the charger between two runs. Opportunity charges are necessary to extend the vehicle's daily driving range from its normal range of 80 km (50 miles) per charge to over 97 km (60 miles). Operators are encouraged to put the vehicles on opportunity charges as often as possible.

6/ VEHICLE MAINTENANCE

6.1/ Electric Drive System

The traction battery pack, traction motor, system interface module, and the controller assembly form the propulsion system of the Griffon electric van. The brake vacuum pump, the Eberspacher D4L heater, and the "Autofil" dolly form an integral part of the electric drive system. All the work done on these sub-systems is accounted for under the electric drive system.

The topping up of the traction battery pack water is set at two-week intervals. The regular maintenance of the traction motor involves carbon brush inspection and air filter cleaning. This was carried out whenever the vehicles were removed from courier service for other maintenance work.

There was no regular service scheduled for the system interface module, and the controller assembly. They were checked only when necessary.

During the second six-month operational period, the battery pack was inspected and washed. On January 13, 1987 a battery discharge test was conducted by Chloride Electric Vehicle Systems Ltd. for both battery packs. The purpose of the discharge test was to check the battery pack capacity to identify and to correct any possible weak link in the battery string. That is, to check for too much voltage drop in a connecting cable or the terminal voltage of a particular battery module dropping before it delivers its rated capacity. The test records are given in Appendix C; the test results are presented in Tables 2 and 3.

6.2/ Automotive System

All required work, excluding that done on the propulsion system, was considered automotive system maintenance. There was no fixed maintenance schedule for this work. The two vehicles are closely monitored and are removed from courier service whenever attention is required for either improvement or repair. Communication with vehicle operators is maintained on a daily basis and the Electric Vehicle Section makes every effort to co-operate with the operators.

7/ DYNAMOMETER TEST

During the second six-month operational period, both EV 11 and EV 12 were taken out of courier service and tested on the Clayton mechanical dynamometer for the SAE J227a C cycle range test. The main purpose of the tests was to establish the range performance level of the traction battery pack for future reference. Once a bench mark has been established, a repeated test in the future will tell how much the battery capacity has since deteriorated in terms of the number of C cycles. Such a test will not replace the normal battery discharge test.

The results of the SAE J227a C cycle range test of the EV 11 and EV 12 are presented in Table 1.

8/ OPERATION DATA COLLECTION

8.1/ Vehicle Distance

Vehicle operators are required to complete a daily report, recording the daily distance travelled, and remarks regarding the vehicle. In this report the term "full-day service" shall signify that the vehicle completed the scheduled three return trips of the day. The daily distance travelled, then, would be more than 92 km (57 miles). The odometer of the Griffon is in imperial units. Therefore, miles are used in the daily report.

8.2/ Electricity

The power requirement and energy consumption of the battery charger are recorded on a magnetic cassette tape, which is changed monthly. The data retrieval and analysis of the data stored on the tape were performed by the Load Research Section of the Rates and Strategic Conservation Department in the Market Services and Development Division of Ontario Hydro.

8.3/ Heater Fuel

Both winterized diesel oil and kerosene were used for the Eberspacher D4L heater. The use of kerosene was recommended for extreme cold weather and was used during the first six-month period. During the second six-month period, only winterized diesel oil was used and the heater operated satisfactorily even at ambient temperatures around - 20° C. Therefore, only diesel oil will be used in future.

8.4/ Maintenance

Weekly vehicle washing, cleaning, and expendable goods, such as windshield wash, are not being accounted for in calculating the maintenance cost. Neither is the door lock, door hinge, and sheet metal crack repairs, which have nothing to do with the electric vehicle drive or a normal internal combustion engine vehicle.

The routine topping up of battery water is separated from all other maintenance work. The man-hours accounted for were the actual time spent on carrying out the repair.

8.5/ Ambient Temperature

As the lead-acid battery performance will be affected by its ambient temperature, the temperature record at Toronto Pearson International Airport recorded by Environment Canada was used to estimate the battery ambient temperature. It is called "battery temperature" for convenience in this report. As the electric vehicles are normally kept indoors when they are off the road, the average value of the daily maximum and the daily mean temperatures is used as the daily average battery temperature.

Appendix D, Daily Temperature Record, shows the daily maximum, daily mean, and the battery ambient temperatures during the twelve-month period in chronological order.

9/ OPERATIONAL RESULTS

9.1/ Vehicle Distance

In the second six-month period, EV 11 accumulated 8811 km (5475 miles) and EV 12 accumulated 8187 km (5087 miles). The accumulated first-year vehicle distances of the EV 11 and EV 12 were 20 373 km (12 659 miles) and 19 329 km (12 013 miles) respectively. The number of full days of service achieved by the EV 11 and EV 12 for the second six-month period were 66 days and 69 days respectively out of 122 potential service days. The annual figures were 176 days and 163 days out of 249 potential service days for EV 11 and EV 12 respectively. The causes of those lost days were recorded. For detail, please refer to Appendix B.

Appendix A, Operation Record, gives the daily vehicle odometer readings, distance, and battery charges for EV 11 and EV 12 in chronological order.

Appendix B, Days Vehicle Did Not Complete Full-Day Service, gives the date, odometer readings, distance, and the cause for EV 11 and EV 12 in chronological order.

9.1.1/ Human Factor

The success of electric vehicle testing is dependent on the attitude of the vehicle operator. In the second six-month period, there were thirteen days that the EV 11 was capable of completing full-day service but was short of one return trip solely due to the lack of cooperation from the operator. Detailed dates are shown in Appendix B.

9.2/ Electricity Consumption

The maximum electric power demand by the charger, including the power demand by the battery heater, was registered as 7.7 kW on January 21, 1987 at the Bay Street Government Repair Garage location. The maximum daily electric energy consumption was registered as 69.5 kWh on December 12, 1986 at the MTO District 42 Garage location.

The total energy consumption during the second six-month period of the EV 11 and EV 12 were 4733.49 kWh and 4204.94 kWh respectively. The cumulated twelve-month energy consumption of the EV 11 and EV 12 were 10 459.01 kWh and 9559.78 kWh respectively.

Table 4 summarizes different energy consumption figures for the two vehicles. The overall mean energy consumption rate was 0.50 kWh/km (0.81 kWh/mile).

9.2.1/ Effect of Daily Distance

Tables 5 and 6 list the energy consumption per mile for different daily vehicle distances for EV 11 and EV 12. The same results are again expressed in Figures 2 and 3 except that, for simplicity, the plots and the regression analysis do not take the frequency into account. From the two figures it can be seen that there is a correlation between the daily distance travelled and the rate of energy consumption; in general, the longer the daily distance, the lower the energy consumption rate the electric van can achieve.

In the case of EV 11, the energy consumption rates calculated from regression analysis show that for daily distances of 67 miles and 57 miles, the rates are 0.739 kWh/mile and 0.824 kWh/mile respectively, a difference of 11.5%.

9.2.2/ Effect of Environmental Temperature

An analysis of the effect of temperature on energy consumption per mile was done for both EV 11 and EV 12. The conclusion of the analysis is in agreement with the general belief that the efficiency of a lead-acid battery electric vehicle decreases as temperature decreases.

Tables 7 and 8 list the energy consumption per mile and battery temperatures for daily vehicle distances of 62 miles and 60 miles for EV 11 and EV 12 respectively. Figures 4 and 5 present the same information.

In the case of EV 12 with a 60-mile daily distance, the energy consumption rates at 27.1° centigrade and at 0.1° centigrade would be, as calculated from the regression analysis, 0.750 kWh/mile and 0.859 kWh/mile respectively, a difference of 14.5%.

9.3/ Heater Fuel Consumption

During the second six-month period, a total of 40 litres of winterized diesel oil was used by the two vans. The cost was $17.20. The accumulated twelve-month heater fuel cost was $37.20. The overall mean cost of heater fuel was 0.09 ¢/km or 0.15 ¢/mile.

9.4/ Maintenance Cost

9.4.1/ Battery Watering

The consumption of the de-ionized water of the EV 11 and EV 12 for the second six-month period were 70.6 litres and 52.5 litres respectively. The twelve-month cumulative figures were 176.2 litres and 151.6 litres for EV 11 and EV 12 respectively. The complete watering records of the two vans are given in Appendix E.

Table 9 summarizes all information related to watering the batteries.

9.4.2/ Maintenance

Fifteen man-hours for EV 11 and 21 man-hours for EV 12 were spent on repairs exclusively related to the electric drive systems. The 0.5 man-hours spent on replacing the main contactor for the charger at Bay Street Government Repair Garage is included in EV 11.

Tables 10 and 11 give the twelve-month repairing records of the two vans. Note only the items that are exclusively required for electric drive systems are included; repair work such as fixing cracking sheet metal or the door lock is not included.

As the battery charger and watering dolly are shared by both vans, and there are only two vans in operation, the cost of maintenance was calculated for the operation not for individual vehicles. The cost of parts was negligible, because most replaced items were still under warranty at the time.

9.4.3/ Preventive Maintenance

Tables 12 and 13, the preventive maintenance records for the two electric vehicles, are not complete. Work was done, but the dates were lost and/or the man-hours spent were not included. As preventive maintenance work is subject to the discretion of the individual who made the decision, the accuracy of the record is not of great importance and doesn't affect the pertinent electric vehicle operational data.

Eighteen man-hours were used on preventive maintenance for EV 11 and 19 man-hours were used for EV 12.

Table 14 summarizes the overall maintenance cost. It should be noted that these man-hours represent only the amount of time spent on performing the work.

9.5/ Operation Cost

The costs of electricity, heater fuel, battery watering, and maintenance are combined to represent the operation cost. It was calculated for the twelve-month period rather than over six months for better accuracy. The overall mean operation cost per unit distance was 10.61 cents per kilometre or 17.08 cents per mile. Table 15 gives the details.

10/ CONCLUSION

For the period of May 14, 1986 to May 13, 1987, the distances logged by EV 11 and EV 12 were 20 373 km (12 659 miles) and 19 329 km (12 013 miles), respectively.

EV 11 was in full-day service for 176 out of 249 days and EV 12 was in full-day service for 163 out of 249 days. The causes of lost days vary. They are listed in Appendix B.

The overall mean energy consumption per unit distance was 0.50 kWh/km (0.81 kWh/mile). The corresponding cost was 1.90 ¢/km (3.08 ¢/mile).

The overall mean battery water consumption per unit distance was 8.26 millilitre/km (13.29 millilitre/mile). The overall mean cost of watering, water, and labour per unit distance was 1.87 ¢/km (3.01 ¢/mile).

The overall mean maintenance time per unit distance was 6.62 s/km (10.65 s/mile). The overall mean maintenance cost, including parts and labour, per unit distance was 6.71 ¢/km (10.79 ¢/mile).

The overall mean operation cost per unit distance was 10.59 ¢/km (17.03 ¢/mile).

The electric vehicle performance, the vehicle range in particular, does depend on the attitude of its operator. An unco-operative operator can really lower the vehicle performance level.

In general, the longer the daily vehicle distance, the lower the energy consumption rate the electric van can achieve.

The lead-acid battery works more efficiently in warm weather than in cold weather. This characteristic has a bearing on the operation of electric vehicles in the Toronto area, and in all parts of Canada.

REFERENCES

[1] Hsu, D., J. Duncan, "Electric Vans -- Progress Report," Transportation Technology and Energy Branch Report EV-86-01, Ministry of Transportation, October 1986.

[2] Hsu, D., J. Duncan, "Electric Vans in Courier Service: Six-Month Progress Report," Transportation Technology and Energy Branch, Report EV-87-01, Ministry of Transportation, September 1987.

Table 1/ SAE J227a C Cycle Test

Vehicle	EV 11	EV 12
Date	86-12-17	86-10-28
No. of cycles completed	160 (1)	160 (1)
Battery output	29622 Wh 153.8 AH	27939 Wh n/a
Odometer reading at the end of the test	8930 miles	8378 miles

Notes: (1) The battery pack still had some capacity left in it. That is, there was no red light being observed on the last cycle during the driving test.

(2) The dynamometer settings were:

Equivalent moment of inertia	6750 lbs.
Total resistance	17 HP

Table 2/ Battery Discharge Test Result – EV 11

GM GRIFFON ELECTRIC VAN
BATTERY INSPECTION AND TEST SUMMARY

OPERATOR: Ministry of Transportation **BATTERY NO**: B12620 **TEST DATE**: Jan.13,1987
LOCATION: Toronto **VEH REG NO**: FV 616930 **MILEAGE**: 9659 miles
EV 11 **TEST ENGINEER**: D.P. Harris

1/ BATTERY INSPECTION: completed and satisfactory [√]
attention required [ ]

2/ WATERING SYSTEM INSPECTION:
completed and satisfactory [√]
attention required [ ]

3/ BATTERY DISCHARGE TEST:

Average Pack Discharge Voltage	200.4 V
Discharge Start Temperature	25°C
End of Discharge Temperature	32°C
Average Temperature	27.6°C
Average Discharge Rate:	89 A
Charge Delivered (Standardized to 30°C)	130 Ah
Module Voltages at 185V: Mean	5.25 V
Standard Deviation	.047
Discharge Energy (Standardized to 30°C)	25.35 kWh
Nominal Capacity (Standardized to 30°C)	93%

COMMENTS: Pack in good condition

Data Examined By: R.P. Lim
Date: 5/2/87

Table 3/ Battery Discharge Test Result – EV 12

GM GRIFFON ELECTRIC VAN
BATTERY INSPECTION AND TEST SUMMARY

OPERATOR: Ministry of Transportation **BATTERY NO**: B12610 **TEST DATE**: Jan.13,1987
LOCATION: Toronto **VEH REG NO**: FV 616917 **MILEAGE**: 9736 miles
EV 12 **TEST ENGINEER**: D.P. Harris

1/ BATTERY INSPECTION: completed and satisfactory [√]
attention required [ ]

2/ WATERING SYSTEM INSPECTION:
completed and satisfactory [√]
attention required [ ]

3/ BATTERY DISCHARGE TEST:

Average Pack Discharge Voltage	195 V
Discharge Start Temperature	23°C
End of Discharge Temperature	28°C
Average Temperature	25°C
Average Discharge Rate:	89 A
Charge Delivered (Standardized to 30°C)	130 Ah
Module Voltages at 185V: Mean	5.26 V
Std Development	.055
Discharge Energy (Standardized to 30°C)	26.05 kWh
Nominal Capacity (Standardized to 30°C)	93%

COMMENTS: Pack in good condition

Data Examined By: R. Y. Sun
Date: 5/2/87

Table 4/ Summary of Energy Consumption (From May 14, 1986 to May 13, 1987)

Vehicle	EV 11	EV 12
Total number of days	365	365
Potential service days	249	249
Total accumulated distance	20 373 km 12 659 miles	19 329 km 12 013 miles
Number of days vehicle completed a full-day service	176	163
Total accumulated distance from from full-day services	17 496 km 10 872 miles	16 259 km 10 103 miles
Mean daily distance for a full-day service	99.41 km 61.77 miles	99.75 km 61.98 miles
Mean daily ac energy consumption for a full-day service	47.71 kWh	48.67 kWh
Mean ac energy consumption per unit distance for a full-day service	0.48 kWh/km 0.77 kWh/mile	0.49 kWh/km 0.79 kWh/mile
Mean daily opportunity charge ac energy consumption for a full-day service	8.07 kWh	9.21 kWh
Total number of weekend days and holidays	116	116
Mean daily trickle charge ac energy consumption on weekend or holiday	2.47 kWh	2.55 kWh
Total number of days vehicle did not complete a full-day service	73	86
Overall mean ac energy consumption per unit distance	0.50 kWh/km 0.81 kWh/mile	
Overall Mean Energy Cost per unit Distance at 3.80 ¢/kWh	1.90 ¢/km 3.08 ¢/mile	

Table 5/ Energy Consumption Rate Versus Daily Distance – EV 11

Daily Distance (miles)	Frequency (days)	Energy Consumption Rate kWh/mile	
		Actual Value	Calculated Value (Regression Analysis)
67	7	0.810	0.739
66	8	0.740	0.748
65	7	0.734	0.756
64	8	0.745	0.765
63	30	0.750	0.773
62	24	0.779	0.782
61	17	0.771	0.790
60	41	0.777	0.799
59	17	0.798	0.807
58	6	0.806	
0.815			
57	2	0.888	0.824

Table 6/ Energy Consumption Rate Versus Daily Distance – EV 12

Daily Distance (miles)	Frequency (days)	Energy Consumption Rate kWh/mile	
		Actual Value	Calculated Value (Regression Analysis)
67	3	0.750	0.742
66	6	0.746	0.751
65	4	0.767	0.759
64	18	0.745	0.767
63	43	0.766	0.775
62	19	0.811	0.783
61	20	0.786	0.791
60	30	0.783	0.799
59	7	0.825	0.808
58	3	0.828	0.816
57	3	0.809	0.824

Table 7/ Energy Consumption Rate Versus Temperature – EV 11

Daily Distance (miles)	Battery Temperature (Centigrade)	Energy Consumption Rate kWh/mile	
		Actual Value	Calculated Value (Regression anslysis)
62	27.80	0.689	0.740
62	23.95	0.708	0.752
62	23.20	0.693	0.754
62	23.20	0.766	0.754
62	21.55	0.876	0.759
62	20.35	0.743	0.763
62	19.75	0.858	0.765
62	19.35	0.839	0.766
62	17.85	0.836	0.771
62	17.45	0.732	0.772
62	17.30	0.719	0.773
62	15.20	0.818	0.779
62	14.35	0.722	0.782
62	14.20	0.708	0.782
62	13.30	0.839	0.785
62	12.90	0.720	0.786
62	12.70	0.765	0.787
62	12.50	0.755	0.787
62	12.10	0.703	0.789
62	11.40	0.953	0.791
62	7.50	0.788	0.803
62	2.70	0.874	0.818
62	1.95	0.795	0.820
62	0.95	0.806	0.824
62	-2.95	0.830	0.836

Table 8/ Energy Consumption Rate Versus Temperature – EV 12

Daily Distance (miles)	Battery Temperature (Centigrade)	Energy Consumption Rate kWh/mile Actual Value	Calculated Value (Regression anslysis)
60	27.1	0.769	0.750
60	24.1	0.764	0.762
60	24.0	0.760	0.762
60	23.8	0.770	0.763
60	23.6	0.749	0.764
60	23.2	0.782	0.766
60	22.0	0.735	0.771
60	21.7	0.768	0.772
60	21.6	0.746	0.772
60	21.5	0.799	0.773
60	21.2	0.810	0.774
60	20.4	0.797	0.777
60	19.9	0.752	0.779
60	19.8	0.774	0.779
60	19.8	0.765	0.779
60	19.7	0.773	0.780
60	18.6	0.767	0.784
60	18.0	0.709	0.787
60	17.9	0.801	0.787
60	17.0	0.819	0.791
60	16.9	0.783	0.791
60	16.5	0.815	0.793
60	16.2	0.812	0.794
60	15.2	0.821	0.798
60	15.0	0.783	0.799
60	14.2	0.789	0.802
60	14.2	0.828	0.802
60	13.3	0.786	0.806
60	0.1	0.868	0.859

Table 9/ Battery Water Consumption
(From May 14, 1986 to May 13, 1987)

Vehicle	EV 11	EV 12
Number of fill-ups	27	25
Total consumption	176.2 L	151.6 L
Mean water consumption per fill-up	6.626 L	6.064 L
Total vehicle distance	20 373 km 12 659 miles	19 329 km 12 013 miles
Mean water consumption per unit distance	8.65 mL/km 13.92 mL/mile	7.84 mL/km 12.62 mL/mile
Cost of water	$73.16	$62.94
Mean cost of water per unit distance	0.36 ¢/km 0.58 ¢/mile	0.33 ¢/km 0.52 ¢/km
Total man-hours for fill-ups	9.00 man-hours	8.33 man-hours
Cost of labour $35.00/man-hour	$315.00	$291.55
Total cost water and labour	$388.16	$354.49
Mean cost of water and labour per unit distance	1.91 ¢/km 3.07 ¢/mile	1.83 ¢/km 2.95 ¢/mile
Overall mean cost of watering per unit distance	1.87 ¢/km 3.01 ¢/mile	

Table 10/ EV 11 Maintenance Record

DATE	ODOMETER	SYMPTOM	CURE	MAN-HOURS *EVDS	MAN-HOURS AUTO	$ PARTS
07/31/86	4292	watering system leaked air	cell cap	2.0		0
10/16/86	7190	brake vacuum pump ran continuously	pump re-assembled pressure switch re-set	3.0		0
12/09/86	8610	bay garage charger working intermitently	main contactor replaced	0.5		0
01/27/87	10151	water dolly not enough vacuum	plastic foreign object removed from pump valve	3.0		0
02/17/87	10770	heater fuel leaked	clamp tightened	0.5		0
02/27/87	11158	acid leaked under charge	repaired water dolly			0
03/10/87	11460	heater did not burn well	tune-up	1.0		0
03/12/87	11488	watering block not working	replaced	2.0		0
04/03/87	12178	vacuum pump not working heater fuel leaked	fuse replaced pump overhauled	1.0 2.0		1 0
TOTAL				15		1

*EVDS – Electric Vehicle Drive System
Auto – Automotive

Table 11/ EV 12 Maintenance Record

DATE	ODOMETER	SYMPTOM	CURE	MAN-HOURS EVDS	MAN-HOURS AUTO	$ PARTS
06/24/86	3435	R.H.S. watering system leak	rubber hose replaced	4		0
08/20/86	5777	IGN light stayed on	fuse 1 amp in SIM	2		1
09/12/86	6740	vacuum pump would not be turned on	relay replaced	3		5
10/23/86	8291	brake vacuum pump stayed on too long	pump overhauled	3		0
10/24/86	8291	not enough air flow to wind shield side door difficult to close	damp control adjusted door jam trimmed		4 2	0
11/03/86	8469	heater would turn off as soon as the IGN was turned off	temperature switch replaced	1		
12/10/86	9600	battery would not fully charge up, sometimes the charger gave no output	left main contractor replaced	2		0
12/17/86	9556	charge indicator drops faster than the actual battery voltage drop	nothing was done			0
02/05/87	9997	same as above	one auxiliary board in controller and one board in SIM box were replaced	4		0
03/31/87	11947	heater stuck on	relay checked	2		0
TOTAL				21		6

Table 12/ EV 11 Preventive Maintenance Record

DATE	ODOMETER	SYMPTOM	MAINTENANCE	MAN-HOURS EVDS	MAN-HOURS AUTO	$ PARTS
06/19/86	2573	rear step board hit legs while transfering load	took out		1	0
07/31/86	4292	motor air filter	cleaned	1		0
		motor carbon brush	inspected	1		0
11/25/86	8309	side mirrors	replaced with mirrors 6" x 9"		3	50
12/15/86	8812	motor air filter	cleaned	1		0
		motor carbon brush	inspected	1		0
		U-joint, ball joint	greased		1	0
01/12/87	9659	battery	discharge test	3		0
		motor	inspected	1		0
03/12/87	11488	battery	cleaned	3		0
		motor	inspected	1		0
		U-joint, ball joint	greased	3	1	0
TOTAL				12	6	50

Table 13/ EV 12 Preventive Maintenance Record

DATE	ODOMETER	SYMPTOM	MAINTENANCE	MAN-HOURS EVDS	AUTO	PARTS
10/24/86	8297	motor air filter	cleaned	1		0
		motor carbon brush	inspected	1		0
		differential gear box	oil added		2	0
10/31/86	8434	side mirrors	replaced with mirrors 6"x 9"		3	50
12/16/86	9612	motor air filter	cleaned	1		0
		motor carbon brush	inspected	1		0
		U-joint, ball joint	greased		1	0
01/13/87	9735	battery	discharge test	3		0
		motor	inspected	1		0
03/23/87	11689	battery	cleaned	3		0
		motor	inspected	1		0
		U-joint, ball joint	greased		1	0
TOTAL				12	7	50

Table 14/ Maintenance Cost
From May 14, 1986 to May 13, 1987

Vehicle	EV 11	EV 12
Maintenance man-hours	15	21
Preventive Maintenance man-hours	18	19
Total maintenance man-hours	33	40
Cost of labour at $35.00/man-hour	$1155.00	$1400.00
Total vehicle distance	20 373 km 12 659 miles	19 329 km 12 013 miles
Cost of parts	$51.00	$56.00
Total cost	$1206.00	$1456.00
Maintenance cost per unit distance	5.92 ¢/km 9.53 ¢/mile	7.53 ¢/km 12.12 ¢/mile
Overall Mean Maintenance Cost per Unit Distance	6.71 ¢/km 10.79 ¢/mile	

Table 15/ Operation Cost
From May 14, 1986 to May 13, 1987

Vehicle	EV 11	EV 12
Total accumulated distance	20 373 km 12 659 miles	19 329 km 12 013 miles
Electricity cost	$397.44	$363.27
Heater fuel cost	$18.60	$18.60
Watering cost	$388.16	$354.49
Maintenance cost	$1206.00	$1456.00
Total Operation Cost	$2010.20	$2192.36
Mean operation cost per unit distance	9.87 ¢/km 15.88 ¢/mile	11.34 ¢/km 18.25 ¢/mile
Overall Mean Operation Cost per Unit Distance	10.59 ¢/km 17.03 ¢/mile	

Figure 1/ Courier Service Route

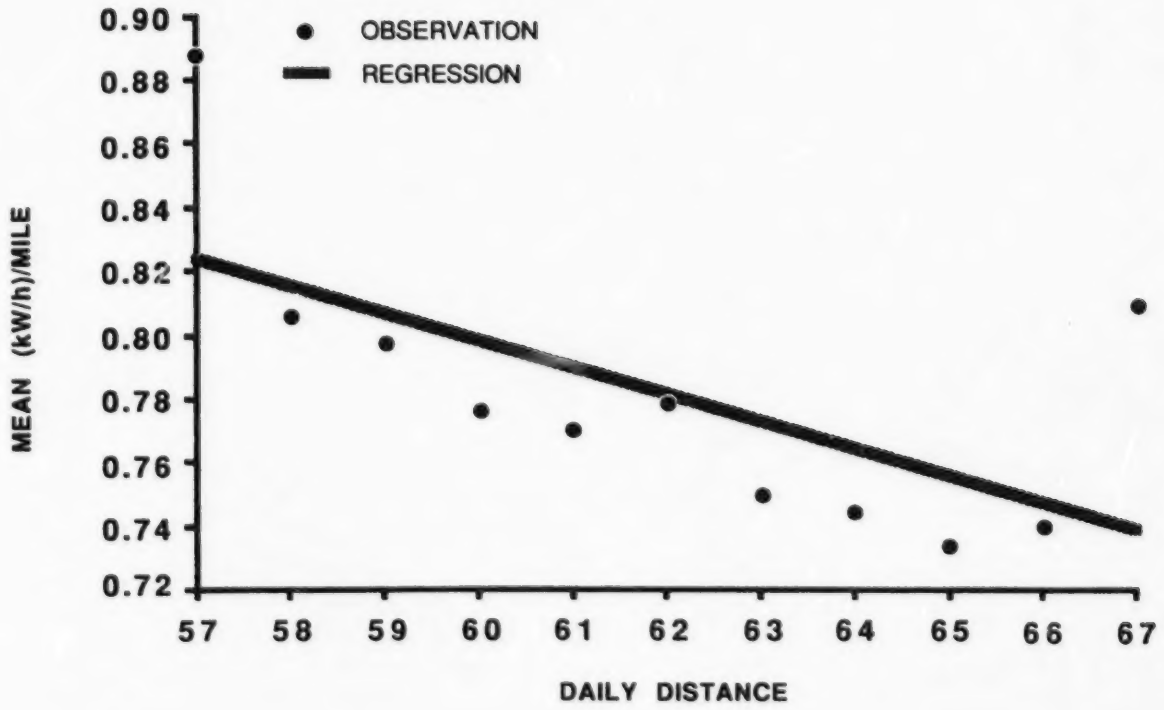

Figure 2/ Energy Consumption Rate vs Daily Distance – EV 11

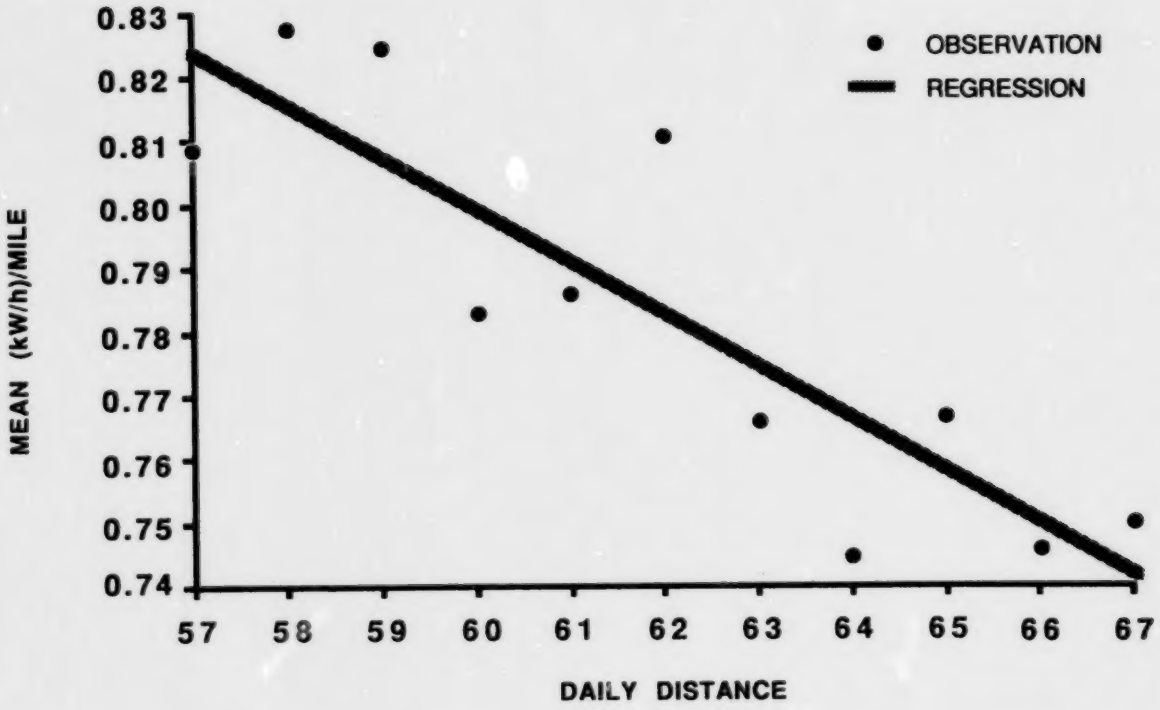

Figure 3/ Energy Consumption Rate vs Daily Distance – EV 12

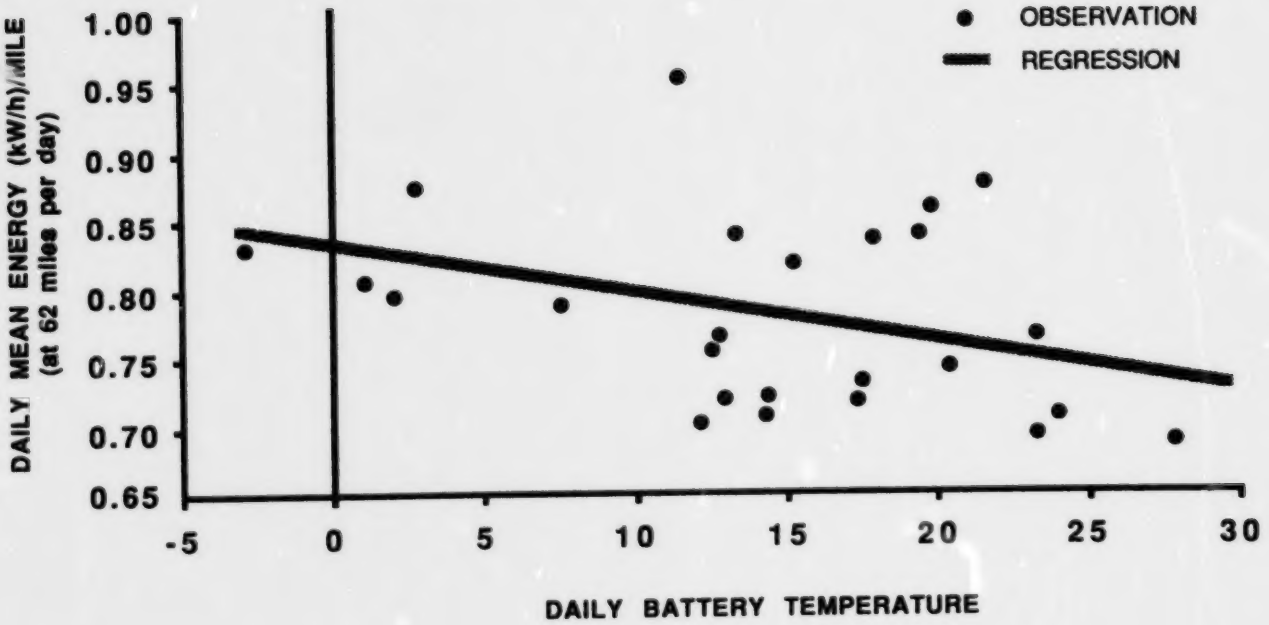

Figure 4/ Energy Consumption Rate vs Battery Temperature – EV 11

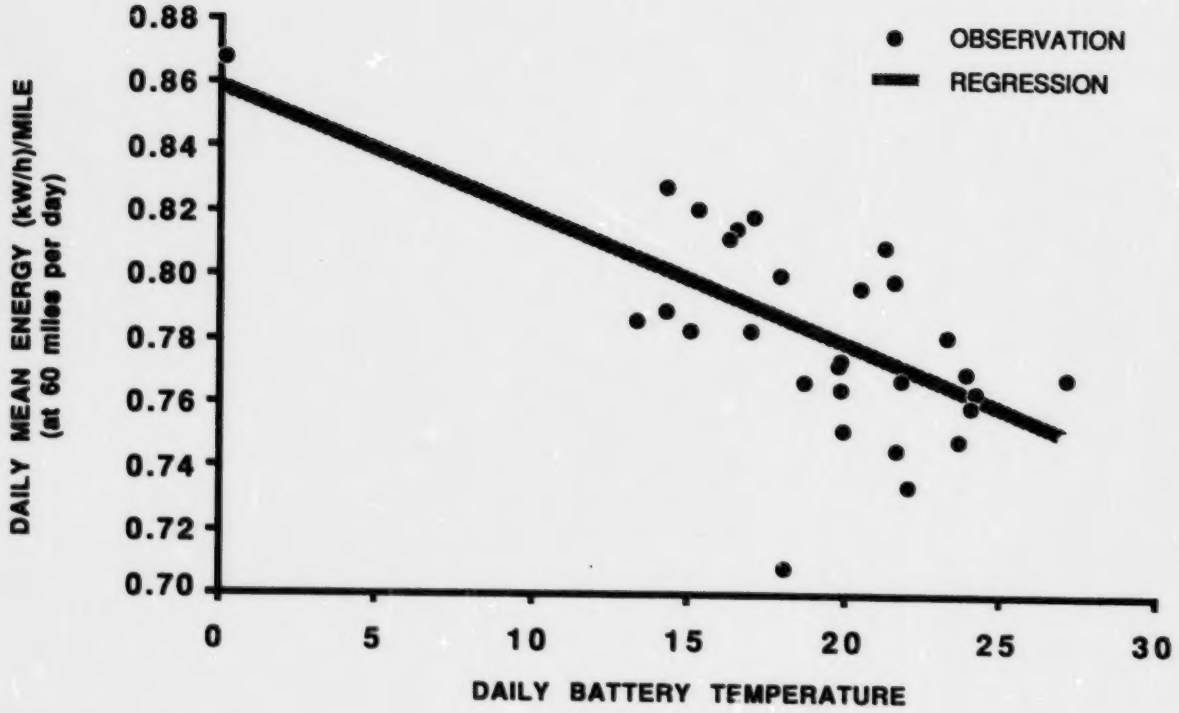

Figure 5/ Energy Consumption Rate vs Battery Temperature – EV 12

APPENDIX A

OPERATION RECORD IN CHRONOLOGICAL ORDER

OPERATION RECORD
EV 11

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
05/14/86	1084	1146	62	8.95	42.45	0.60	52.00
05/15/86	1146	1208	62	6.96	44.88	0.00	51.84
05/16/86	1208	1270	62	10.15	42.47	0.60	53.22
05/17/86	SATURDAY		0			2.15	2.15
05/18/86	SUNDAY		0			2.15	2.15
05/19/86	HOLIDAY		0			2.15	2.15
05/20/86	1270	1332	62	8.97	42.91	7.19	59.07
05/21/86	1332	1395	63	10.27	39.33	0.62	50.22
05/22/86	1395	1462	67	8.47	46.80	0.58	55.85
05/23/86	1462	1526	64	9.00	48.56	0.60	58.16
05/24/86	SATURDAY		0			2.15	2.15
05/25/86	SUNDAY		0			2.15	2.15
05/26/86	1526	1589	63	6.88	40.49	5.10	52.47
05/27/86	1589	1656	67	6.27	48.38	0.61	55.26
05/28/86	1656	1721	65	8.30	42.28	0.61	51.19
05/29/86	1721	1782	61	7.64	41.26	0.60	49.50
05/30/86	1782	1816	34	7.64	17.98	0.63	26.25
05/31/86	SATURDAY		0			2.15	2.15
06/01/86	SUNDAY		0			2.15	2.15
06/02/86	1816	1857	41	16.91	29.21	0.00	46.12
06/03/86	1857	1914	57	7.35	40.26	0.52	48.13
06/04/86	1914	1974	60	8.47	38.40	0.53	47.40
06/05/86	1974	2032	58	8.01	39.19	0.52	47.72
06/06/86	2032	2092	60	8.40	40.53	0.53	49.46
06/07/86	SATURDAY		0			2.15	2.15
06/08/86	SUNDAY		0			2.15	2.15
06/09/86	2092	2151	59	8.21	37.95	4.53	50.69
06/10/86	2151	2213	62	12.74	38.76	0.50	52.00
06/11/86	2213	2268	55	7.10	41.17	0.51	48.78
06/12/86	2268	2328	60	7.22	43.14	0.54	50.90
06/13/86	2328	2386	58	6.64	37.09	0.53	44.26
06/14/86	SATURDAY		0			2.15	2.15
06/15/86	SUNDAY		0			2.15	2.15
06/16/86	2386	2443	57	7.57	41.08	4.46	53.11
06/17/86	2443	2502	59	7.91	39.55	0.51	47.97
06/18/86	2502	2562	60	7.47	40.55	0.54	48.56
06/19/86	2562	2573	11	0.00	11.84	0.00	11.84
06/20/86	2573	2636	63	6.75	37.14	0.56	44.45
06/21/86	SATURDAY		0			2.15	2.15
06/22/86	SUNDAY		0			2.15	2.15
06/23/86	2636	2703	67	7.28	44.60	8.44	60.32
06/24/86	2703	2769	66	7.37	46.34	0.63	54.34
06/25/86	2769	2836	67	7.61	44.28	0.57	52.46
06/26/86	2836	2903	67	7.91	44.55	0.61	53.07
06/27/86	2903	2967	64	7.04	38.45	0.61	46.10
06/28/86	SATURDAY		0			2.15	2.15
06/29/86	SUNDAY		0			2.15	2.15
06/30/86	2967	3030	63	9.05		5.16	14.21
07/01/86	HOLIDAY		0			0.00	0.00

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
07/02/86	3030	3073	43	15.03	51.52	0.00	66.55
07/03/86	3073	3136	63	6.34	39.95	0.55	46.84
07/04/86	3136	3200	64	7.74	37.07	0.63	45.44
07/05/86	SATURDAY		0			2.40	2.40
07/06/86	SUNDAY		0			2.28	2.28
07/07/86	3200	3265	65	7.24	37.20	0.59	45.03
07/08/86	3265	3331	66	6.65	39.86	0.61	47.12
07/09/86	3331	3386	55	6.75	39.19	0.62	46.56
07/10/86	3386	3456	70	6.72	39.22	0.57	46.51
07/11/86	3456	3517	61	8.94	35.60	0.61	45.15
07/12/86	SATURDAY		0			2.19	2.19
07/13/86	SUNDAY		0			2.02	2.02
07/14/86	3517	3558	41	4.21	27.48	0.54	32.23
07/15/86	3558	3620	62	8.05	35.25	0.57	43.87
07/16/86	3620	3655	35	1.82	22.49	0.00	24.31
07/17/86	3655	3715	60	7.53	34.36	0.56	42.45
07/18/86	3715	3777	62	7.97	34.22	0.54	42.73
07/19/86	SATURDAY		0			2.09	2.09
07/20/86	SUNDAY		0			2.05	2.05
07/21/86	3777	3837	60	6.94	39.10	0.53	46.57
07/22/86	3837	3897	60	7.60	35.79	0.57	43.96
07/23/86	3897	3960	63	7.52	40.13	0.57	48.22
07/24/86	3960	4021	61	7.00	37.05	0.55	44.60
07/25/86	4021	4084	63	6.39	36.40	0.58	43.37
07/26/86	SATURDAY		0			2.13	2.13
07/27/86	SUNDAY		0			2.07	2.07
07/28/86	4084	4144	60	7.09	38.49	0.52	46.10
07/29/86	4144	4202	58	8.37	35.43	0.37	44.37
07/30/86	4202	4261	59	4.06	39.77	0.56	44.39
07/31/86	4261	4292	31	3.16	22.28	0.00	25.44
08/01/86	4292	4358	66	7.50	39.74	0.62	47.86
08/02/86	SATURDAY		0			2.43	2.43
08/03/86	SUNDAY		0			2.24	2.24
08/04/86	HOLIDAY		0			2.17	2.17
08/05/86	4358	4424	66	6.83	40.73	0.55	48.11
08/06/86	4424	4487	63	6.70	33.83	0.61	41.14
08/07/86	4487	4555	68	7.68	42.60	0.60	50.88
08/08/86	4555	4621	66	7.93	37.06	0.62	45.61
08/09/86	SATURDAY		0			2.28	2.28
08/10/86	SUNDAY		0			2.17	2.17
08/11/86	4621	4684	63	6.86	38.94	0.54	46.34
08/12/86	4684	4747	63	6.21	39.82	0.58	46.61
08/13/86	4747	4812	65	3.51	42.02	0.60	46.13
08/14/86	4812	4877	65	8.05	37.38	0.60	46.03
08/15/86	4877	4942	65	4.90	44.47	1.65	51.02
08/16/86	SATURDAY		0			1.79	1.79
08/17/86	SUNDAY		0			2.76	2.76
08/18/86	4942	5007	65	6.40	38.34	0.55	45.29
08/19/86	5007	5041	34	3.30	24.85	0.59	28.74
08/20/86	5041	5105	64	6.70	38.89	0.61	46.20
08/21/86	5105	5168	63	6.59	39.99	0.63	47.21
08/22/86	5168	5218	50	3.35	37.02	0.58	40.95
08/23/86	SATURDAY		0			2.30	2.30

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
08/24/86	SUNDAY		0			2.12	2.12
08/25/86	5218	5281	63	6.83	39.64	0.53	47.00
08/26/86	5281	5343	62	7.40	39.47	0.63	47.50
08/27/86	5343	5410	67	6.78	44.49	0.58	51.85
08/28/86	5410	5473	63	6.92	39.72	0.58	47.22
08/29/86	5473	5534	61	9.17	33.88	0.59	43.64
08/30/86	SATURDAY		0			2.41	2.41
08/31/86	SUNDAY		0			2.30	2.30
09/01/86	HOLIDAY		0			4.24	4.24
09/02/86	5534	5597	63	7.28	35.31	0.57	43.16
09/03/86	5597	5663	66	4.52	41.47	0.61	46.60
09/04/86	5663	5725	62	5.52	36.86	0.60	42.98
09/05/86	5725	5787	62	4.56	40.88	0.64	46.08
09/06/86	SATURDAY		0			4.59	4.59
09/07/86	SUNDAY		0			2.26	2.26
09/08/86	5787	5854	67	6.68	43.81	0.54	51.03
09/09/86	5854	5917	63	7.75	38.74	0.63	47.12
09/10/86	5917	5980	63	5.55	36.29	0.63	42.47
09/11/86	5980	6000	20	9.92	12.92	0.62	23.46
09/12/86	6000	6003	3	0.00	7.44	1.18	8.62
09/13/86	SATURDAY		0			2.84	2.84
09/14/86	SUNDAY		0			2.23	2.23
09/15/86	6003	6051	48	3.86	34.11	0.57	38.54
09/16/86	6051	6117	66	6.65	47.80	0.58	55.03
09/17/86	6117	6183	66	4.82	40.91	0.58	46.31
09/18/86	6183	6245	62	9.15	40.96	0.60	50.71
09/19/86	6245	6307	62	7.57	36.40	0.60	44.57
09/20/86	SATURDAY		0			2.35	2.35
09/21/86	SUNDAY		0			2.33	2.33
09/22/86	6307	6367	60	8.16	39.00	0.56	47.72
09/23/86	6367	6428	61	9.14	35.92	0.60	45.66
09/24/86	6428	6492	64	8.00	38.21	0.60	46.81
09/25/86	6492	6553	61	7.63	39.71	0.57	47.91
09/26/86	6553	6616	63	7.71	37.77	0.60	46.08
09/27/86	SATURDAY		0			2.33	2.33
09/28/86	SUNDAY		0			2.23	2.23
09/29/86	6616	6678	62	13.53	40.23	0.55	54.31
09/30/86	6678	6687	9	1.53	11.37	0.60	13.50
10/01/86	6687	6750	63	9.13	38.53	1.16	48.82
10/02/86	6750	6813	63	8.34	40.37	0.63	49.34
10/03/86	6813	6876	63	7.02	43.03	0.63	50.68
10/04/86	SATURDAY		0			2.40	2.40
10/05/86	SUNDAY		0			2.35	2.35
10/06/86	6876	6939	63	9.38	42.39	0.52	52.29
10/07/86	6939	7004	65	11.63	37.14	0.63	49.40
10/08/86	7004	7067	63	10.59	39.33	0.66	50.58
10/09/86	7067	7130	63	7.32	44.01	0.62	51.95
10/10/86	7130	7169	39		15.47	0.58	16.05
10/11/86	SATURDAY		0				0.00
10/12/86	SUNDAY		0				0.00
10/13/86	HOLIDAY		0				0.00
10/14/86	7169	7170	1		12.89		12.89
10/15/86	7170	7170	0			2.79	2.79

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
10/16/86	7170	7190	20			0.55	0.55
10/17/86	7190	7222	32	18.15	23.19		41.34
10/18/86	SATURDAY		0			2.36	2.36
10/19/86	SUNDAY		0			2.36	2.36
10/20/86	7222	7283	61	6.33	39.33	1.03	46.69
10/21/86	7283	7343	60	7.16	39.27	0.55	46.98
10/22/86	7343	7403	60	7.66	36.74	0.53	44.93
10/23/86	7403	7465	62	8.47	38.35	0.61	47.43
10/24/86	7465	7526	61	7.66	39.64	0.57	47.87
10/25/86	SATURDAY		0			2.23	2.23
10/26/86	SUNDAY		0			2.12	2.12
10/27/86	7526	7587	61	7.57	37.51	0.53	45.61
10/28/86	7587	7647	60	8.27	38.44	0.56	47.27
10/29/86	7647	7707	60	7.17	36.40	0.38	43.95
10/30/86	7707	7768	61	7.78	39.24	0.56	47.58
10/31/86	7768	7829	61	6.98	39.98	0.58	47.54
11/01/86	SATURDAY		0			2.20	2.20
11/02/86	SUNDAY		0			2.04	2.04
11/03/86	7829	7890	61	8.88	37.85	0.55	47.28
11/04/86	7890	7951	61	6.53	42.49	0.53	49.55
11/05/86	7951	8011	60	5.72	41.59	0.56	47.87
11/06/86	8011	8071	60	8.11	36.06	0.53	44.70
11/07/86	8071	8132	61	4.82	40.50	0.55	45.87
11/08/86	SATURDAY		0			2.27	2.27
11/09/86	SUNDAY		0			2.15	2.15
11/10/86	8132	8192	60	6.88	40.56	0.54	47.98
11/11/86	HOLIDAY		0			2.12	2.12
11/12/86	8192	8254	62	8.32	45.32	0.53	54.17
11/13/86	8254	8268	14	4.39	13.44	0.56	18.39
11/14/86	8268	8268	0			3.06	3.06
11/15/86	SATURDAY		0			2.46	2.46
11/16/86	SUNDAY		0			2.45	2.45
11/17/86	8268	8268	0			1.23	1.23
11/18/86	8268	8268	0			2.89	2.89
11/19/86	8268	8268	0			3.30	3.30
11/20/86	8268	8306	38	3.30	28.16	0.58	32.04
11/21/86	8306	8306	0	7.65	0.00	1.74	9.39
11/22/86	SATURDAY		0			2.22	2.22
11/23/86	SUNDAY					2.28	2.28
11/24/86	8306	8307	1			2.31	2.31
11/25/86	8307	8309	2	8.01		1.73	9.74
11/26/86	8309	8369	60	7.36	47.41	0.62	55.39
11/27/86	8369	8383	14		13.77	1.24	15.01
11/28/86	8383	8431	48		39.90	0.60	40.50
11/29/86	SATURDAY		0			2.48	2.48
11/30/86	SUNDAY		0			2.47	2.47
12/01/86	8431	8480	49	5.98	39.67	1.12	46.77
12/02/86	8480	8480	0	4.86		1.79	6.65
12/03/86	8480	8522	42		32.28	1.21	33.49
12/04/86	8522	8522	0	4.31		2.36	6.67
12/05/86	8522	8543	21		20.37	1.14	21.51
12/06/86	SATURDAY		0			2.44	2.44
12/07/86	SUNDAY		0			2.39	2.39

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
12/08/86	8544	8598	54				0.00
12/09/86	8598	8610	12				0.00
12/10/86	8610	8654	44				0.00
12/11/86	8654	8718	64				0.00
12/12/86	8718	8782	64				0.00
12/13/86	SATURDAY		0				0.00
12/14/86	SUNDAY		0				0.00
12/15/86	8782	8812	30				0.00
12/16/86	8812	8875	63			0.63	0.63
12/17/86	8875	8930	55				0.00
12/18/86	8930	8989	59				0.00
12/19/86	8989	9018	29				0.00
12/20/86	SATURDAY		0			3.72	3.72
12/21/86	SUNDAY		0			2.89	2.89
12/22/86	9018	9081	63	9.94	38.89	0.54	49.37
12/23/86	9081	9144	63	10.07	38.38	0.66	49.11
12/24/86	9144	9185	41	10.81	22.85	0.66	34.32
12/25/86	X'MAS		0			3.15	3.15
12/26/86	HOLIDAY		0			2.39	2.39
12/27/86	SATURDAY		0			2.33	2.33
12/28/86	SUNDAY		0			2.38	2.38
12/29/86	9185	9247	62	11.90	37.45	0.60	49.95
12/30/86	9247	9310	63	10.56	36.06	0.65	47.27
12/31/86	9310	9353	43	9.10	22.37	0.65	32.12
01/01/87	NEW YEAR		0			3.00	3.00
01/02/87	9353	9355	2	3.18		1.16	4.34
01/03/87	SATURDAY		0			2.90	2.90
01/04/87	SUNDAY		0			2.34	2.34
01/05/87	9355	9416	61	11.71	37.03	0.55	49.29
01/06/87	9416	9477	61	11.17	35.00	0.65	46.82
01/07/87	9477	9537	60	10.56	35.17	0.65	46.38
01/08/87	9537	9600	63	10.68	38.08	0.63	49.39
01/09/87	9600	9659	59	11.01	37.36	0.63	49.00
01/10/87	SATURDAY		0			2.40	2.40
01/11/87	SUNDAY		0			2.40	2.40
01/12/87	9659	9659	0				44.62
01/13/87	9659	9660	1		68.80	1.19	69.99
01/14/87	9660	9670	10		9.60	0.61	10.21
01/15/87	9670	9732	62	9.09	39.10	1.10	49.29
01/16/87	9732	9796	64	9.84	40.00	0.60	50.44
01/17/87	SATURDAY		0			2.29	2.29
01/18/87	SUNDAY		0			3.56	3.56
01/19/87	9796	9855	59	12.25	39.09	0.80	52.14
01/20/87	9855	9914	59	8.65	40.63	0.58	49.86
01/21/87	9914	9973	59	10.44	41.41	0.57	52.42
01/21/87	10960	11019	59	9.73	37.71	0.59	48.03
01/22/87	9973	10031	58	6.18	48.45		54.63
01/23/87	10031	10071	40	7.00	31.84		38.84
01/24/87	SATURDAY		0			2.35	2.35
01/25/87	SUNDAY		0			3.00	3.00
01/26/87	10071	10111	40	2.07	35.41	0.59	38.07
01/27/87	10111	10151	40	4.29	33.74	0.58	38.61
01/28/87	10151	10171	20	5.72	19.92	0.60	26.24

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
01/29/87	10171	10211	40	4.34	34.65	0.55	39.54
01/30/87	10211	10251	40	4.26	32.04	0.60	36.90
01/31/87	SATURDAY		0			4.72	4.72
02/01/87	SUNDAY		0			8.16	8.16
02/02/87	10251	10291	40	3.97	31.16	1.53	36.66
02/03/87	10291	10331	40	4.40	30.42	0.64	35.46
02/04/87	10331	10371	40	3.84	31.67	0.78	36.29
02/05/87	10371	10411	40	5.62	32.47	0.79	38.88
02/06/87	10411	10451	40	4.82	29.66	0.79	35.27
02/07/87	SATURDAY		0			2.35	2.35
02/08/87	SUNDAY		0			2.94	2.94
02/09/87	10451	10491	40	6.34	35.09	0.68	42.11
02/10/87	10491	10531	40	4.14	31.37	0.71	36.22
02/11/87	10531	10591	60	7.30	46.86	0.75	54.91
02/12/87	10591	10650	59	7.86	39.68	0.19	47.73
02/13/87	10650	10710	60	8.83	30.16	0.60	39.59
02/14/87	SATURDAY		0			2.46	2.46
02/15/87	SUNDAY		0			2.39	2.39
02/16/87	10710	10770	60	5.88	38.55	0.61	45.04
02/17/87	10770	10770	0			0.62	0.62
02/18/87	10770	10778	8	5.92		0.57	6.49
02/19/87	10778	10840	62	8.92	41.92	0.60	51.44
02/20/87	10840	10900	60	9.71	38.05	0.62	48.38
02/21/87	SATURDAY		0			2.40	2.40
02/22/87	SUNDAY		0			2.30	2.30
02/23/87	10900	10960	60	12.00	39.86	0.58	52.44
02/25/87	11019	11079	60	8.81	40.24	0.59	49.64
02/26/87	11079	11138	59	10.40	37.70	0.59	48.69
02/27/87	11138	11158	20	4.57	16.91	0.62	22.10
02/28/87	SATURDAY		0			2.38	2.38
03/01/87	SUNDAY		0			2.26	2.26
03/02/87	11158	11218	60	9.50	39.25	0.55	49.30
03/03/87	11218	11278	60	8.35	41.72	0.60	50.67
03/04/87	11278	11336	58	10.01	36.75	0.62	47.38
03/05/87	11336	11378	42	7.57	24.46	0.00	32.03
03/06/87	11378	11437	59	10.00	36.16	0.62	46.78
03/07/87	SATURDAY		0			2.41	2.41
03/08/87	SUNDAY		0			2.40	2.40
03/09/87	11437	11460	23	20.11		0.60	20.71
03/10/87	11460	11460	0				0.00
03/11/87	11460	11470	10	3.11			3.11
03/12/87	11470	11488	18				0.00
03/13/87	11488	11499	11	15.60	12.15		27.75
03/14/87	SATURDAY		0			2.78	2.78
03/15/87	SUNDAY		0			2.21	2.21
03/16/87	11499	11559	60	10.42	36.09	0.54	47.05
03/17/87	11559	11619	60	8.63	35.63	0.59	44.85
03/18/87	11619	11679	60	8.06	33.98	0.59	42.63
03/19/87	11679	11738	59	8.05	36.23	0.61	44.89
03/20/87	11738	11797	59	8.95	36.24	0.62	45.81
03/21/87	SATURDAY		0			2.35	2.35
03/22/87	SUNDAY		0			2.31	2.31
03/23/87	11797	11857	60	9.27	35.87	0.59	45.73

DATE	ODOMETER				BATTERY CHARGE		
DATE	START	END	DIST	OPPO	OR NT	TRICKLE	TOTAL
03/24/87	11857	11915	58	9.41	31.95	0.61	41.97
03/25/87	11915	11975	60	7.73	37.66	0.62	46.01
03/26/87	11975	12035	60	8.08	36.53		44.61
03/27/87	12035	12095	60	9.03	35.96	0.63	45.62
03/28/87	SATURDAY		0			2.43	2.43
03/29/87	SUNDAY		0			2.39	2.39
03/30/87	12095	12156	61	7.40	40.62	0.58	48.60
03/31/87	12156	12177	21	1.48	19.20	0.60	21.28
04/01/87	12177	12178	1			4.94	4.94
04/02/87	12178	12178	0	6.81		0.55	7.36
04/03/87	12178	12203	25	5.98			5.98
04/04/87	SATURDAY		0				0.00
04/05/87	SUNDAY		0				0.00
04/06/87	12203	12213	10	10.11	14.04		24.15
04/07/87	12213	12273	60	8.93	36.08	0.54	45.55
04/08/87	12273	12332	59	6.34	34.84	0.60	41.78
04/09/87	12332	12391	59	8.62	34.71	0.61	43.94
04/10/87	12391	12453	62	7.52	37.27	0.60	45.39
04/11/87	SATURDAY		0			2.30	2.30
04/12/87	SUNDAY		0			2.21	2.21
04/13/87	12453	12513	60	10.00	34.44	0.55	44.99
04/14/87	12513	12573	60	11.52	31.81	0.61	43.94
04/15/87	12573	12632	59	8.42	34.07	0.61	43.10
04/16/87	12632	12691	59	8.16	34.89	0.62	43.67
04/17/87	HOLIDAY		0			2.37	2.37
04/18/87	SATURDAY		0			2.19	2.19
04/19/87	SUNDAY		0			2.30	2.30
04/20/87	HOLIDAY		0			2.30	2.30
04/21/87	12691	12751	60				45.00
04/22/87	12751	12811	60	5.86	38.19	0.61	44.66
04/23/87	12811	12871	60	9.23	33.85	0.60	43.68
04/24/87	12871	12931	60	9.56	33.62	0.63	43.81
04/25/87	SATURDAY		0			2.31	2.31
04/26/87	SUNDAY		0			2.30	2.30
04/27/87	12931	12991	60	8.97	35.58	0.59	45.14
04/28/87	12991	13053	62	7.29	41.00	0.58	48.87
04/29/87	13053	13117	64	8.34	34.55	0.60	43.49
04/30/87	13117	13180	63	8.63	36.19	0.60	45.42
05/01/87	13180	13242	62	12.00	30.95	0.62	43.57
05/02/87	SATURDAY		0			2.41	2.41
05/03/87	SUNDAY		0			2.33	2.33
05/04/87	13242	13305	63	12.77	31.49	0.58	44.84
05/05/87	13305	13367	62	12.95	30.38	0.58	43.91
05/06/87	13367	13431	64	11.25	33.12	0.66	45.03
05/07/87	13431	13493	62	12.23	31.75	0.68	44.66
05/08/87	13493	13555	62	11.64	32.47	0.66	44.77
05/09/87	SATURDAY		0			2.43	2.43
05/10/87	SUNDAY		0			2.29	2.29
05/11/87	13555	13618	63	12.58	29.81	0.61	43.00
05/12/87	13618	13680	62	12.57	33.60	0.67	46.84
05/13/87	13680	13743	63	12.81	31.63	0.67	45.11

APPENDIX B

DAYS VEHICLE DID NOT COMPLETE FULL-DAY SERVICE

OPERATION RECORD
EV 12

DATE	ODOMETER START	ODOMETER END	DISTA	OPPORTUN	BATTERY CHARGE OVER NIG	TRICK	TOTAL
86-05-14	1852	1913	61	6.38	35.95	1.09	43.42
86-05-15	1913	1973	60	4.79	42.70	0.58	48.07
86-05-16	1973	2033	60	8.54	37.30	0.59	46.43
86-05-17	SATURDAY		0			1.71	1.71
86-05-18	SUNDAY		0			2.74	2.74
86-05-19	HOLIDAY		0			2.15	2.15
86-05-20	2033	2092	59	6.13	42.75	0.51	49.39
86-05-21	2092	2151	59	7.49	39.33	0.53	47.35
86-05-22	2151	2211	60	6.30	43.39	0.00	49.69
86-05-23	2211	2271	60	6.90	39.84	0.57	47.31
86-05-24	SATURDAY		0			1.66	1.66
86-05-25	SUNDAY		0			2.66	2.66
86-05-26	2271	2330	59	7.02	39.64	0.58	47.24
86-05-27	2330	2388	58	7.29	40.49	0.58	48.36
86-05-28	2388	2449	61	6.41	42.09	0.60	49.10
86-05-29	2449	2508	59	6.14	40.65	0.61	47.40
86-05-30	2508	2565	57	7.42	37.34	0.59	45.35
86-05-31	SATURDAY		0			2.29	2.29
86-06-01	SUNDAY		0			2.12	2.12
86-06-02	2565	2617	52	17.76	26.31	0.55	44.62
86-06-03	2617	2686	69	7.57	51.29	0.63	59.49
86-06-04	2686	2686	0	4.41	0.62	0.63	5.66
86-06-05	2686	2749	63	5.88	47.17	0.63	53.68
86-06-06	2749	2811	62	7.60	42.31	0.63	50.54
86-06-07	SATURDAU		0			2.53	2.53
86-06-08	SUNDAY		0			2.46	2.46
86-06-09	2811	2856	45	8.86	27.86	0.62	37.34
86-06-10	2856	2879	23	9.32	11.87	1.18	22.37
86-06-11	2879	2942	63	7.44	36.76	1.20	45.40
86-06-12	2942	3005	63	7.58	39.91	0.64	48.13
86-06-13	3005	3067	62	9.36	37.21	0.64	47.21
86-06-14	SATURDAY		0			2.44	2.44
86-06-15	SUNDAY		0			2.42	2.42
86-06-16	3067	3127	60	8.39	35.98	0.60	44.97
86-06-17	3127	3187	60	7.70	38.64	0.61	46.95
86-06-18	3187	3248	61	10.85	34.96	0.67	46.48
86-06-19	3248	3299	51	11.43	25.81	0.63	37.87
86-06-20	3299	3356	57	7.92	37.66	0.59	46.17
86-06-21	SATURDAY		0			2.26	2.26
86-06-22	SUNDAY		0			2.12	2.12
86-06-23	3356	3414	58	6.55	40.57	0.55	47.67
86-06-24	3414	3435	21	0.00	18.09	0.60	18.69
86-06-25	3435	3495	60	5.59	40.33	1.08	47.00
86-06-26	3495	3554	59	5.18	42.60	0.61	48.39
86-06-27	3554	3610	56	6.34	39.23	0.58	46.15
86-06-28	SATURDAY		0			2.30	2.30
86-06-29	SUNDAY		0			2.15	2.15
86-06-30	3610	3669	59	7.86	42.06	0.55	50.47
86-07-01	HOLIDAY		0			2.26	2.26

DATE	ODOMETER START	ODOMETER END	DISTA	OPPORTUN	BATTERY CHARGE OVER NIG	TRICK	TOTAL
86-07-02	3669	3726	57	7.98	38.24	0.56	46.78
86-07-03	3726	3785	59	8.44	41.39	0.62	50.45
86-07-04	3785	3845	60	6.54	40.80	0.58	47.92
86-07-05	SATURDAY		0			1.71	1.71
86-07-06	SUNDAY		0			2.15	2.15
86-07-07	3845	3908	63	7.41	37.32	1.04	45.77
86-07-08	3908	3971	63	5.88	40.81	0.62	47.31
86-07-09	3971	4034	63	7.60	39.48	0.60	47.68
86-07-10	4034	4097	63	5.64	41.77	0.58	47.99
86-07-11	4097	4150	53	14.06	23.51	0.60	38.17
86-07-12	SATURDAY		0			2.48	2.48
86-07-13	SUNDAY		0			2.38	2.38
86-07-14	4150	4219	69	6.40	43.10	1.14	50.64
86-07-15	4219	4285	66	7.44	38.48	0.66	46.58
86-07-16	4285	4351	66	7.49	39.63	0.67	47.79
86-07-17	4351	4377	26	19.23	0.68	0.00	19.91
86-07-18	4377	4440	63	5.93	38.40	1.20	45.53
86-07-19	SATURDAY		0			2.42	2.42
86-07-20	SUNDAY		0			2.39	2.39
86-07-21	4440	4504	64	8.73	36.04	0.60	45.37
86-07-22	4504	4567	63	5.10	43.74	0.63	49.47
86-07-23	4567	4633	66	12.80	33.92	0.65	47.37
86-07-24	4633	4700	67	6.34	42.41	0.64	49.39
86-07-25	4700	4767	67	7.28	42.93	0.64	50.85
86-07-26	SATURDAY		0			2.40	2.40
86-07-27	SUNDAY		0			2.36	2.36
86-07-28	4767	4829	62	13.96	31.02	0.61	45.59
86-07-29	4829	4894	65	8.47	42.21	0.68	51.36
86-07-30	4894	4957	63	7.07	38.20	0.65	45.92
86-07-31	4957	5009	52	6.35	30.36	0.63	37.34
86-08-01	5009	5069	60	7.09	37.89	0.62	45.60
86-08-02	SATURDAY		0			2.35	2.35
86-08-03	SUNDAY		0			2.25	2.25
86-08-04	HOLIDAY		0			2.21	2.21
86-08-05	5069	5129	60	7.33	37.94	0.56	45.83
86-08-06	5129	5190	61	7.72	35.47	0.58	43.77
86-08-07	5190	5251	61	6.13	39.39	0.61	46.13
86-08-08	5251	5312	61	7.22	38.29	0.62	46.13
86-08-09	SATURDAY		0			2.33	2.33
86-08-10	SUNDAY		0			2.25	2.25
86-08-11	5312	5373	61	6.55	37.87	0.55	44.97
86-08-12	5373	5433	60	5.75	39.57	0.58	45.90
86-08-13	5433	5495	62	5.05	41.15	0.62	46.82
86-08-14	5495	5555	60	7.05	38.40	0.60	46.05
86-08-15	5555	5615	60	7.53	38.01	0.60	46.14
86-08-16	SATURDAY		0			2.28	2.28
86-08-17	SUNDAY		0			2.21	2.21
86-08-18	5615	5676	61	7.48	35.74	0.55	43.77
86-08-19	5676	5737	61	6.47	40.29	0.56	47.32
86-08-20	5737	5777	40	7.60	27.89	0.63	36.12
86-08-21	5777	5837	60	7.99	37.63	0.60	46.22
86-08-22	5837	5900	63	8.30	38.40	0.58	47.28
86-08-23	SATURDAY		0			2.36	2.36

DATE	ODOMETER START	ODOMETER END	DISTA	OPPORTUN	OVER NIG	BATTERY CHARGE TRICK	TOTAL
86-08-24	SUNDAY		0			2.22	2.22
86-08-25	5900	5960	60	6.24	39.56	0.55	46.35
86-08-26	5960	6020	60	8.86	37.73	0.58	47.17
86-08-27	6020	6080	60	6.42	41.82	0.63	48.87
86-08-28	6080	6140	60	6.48	40.07	0.58	47.13
86-08-29	6140	6200	60	9.95	38.20	0.59	48.74
86-08-30	SATURDAY		0			2.30	2.30
86-08-31	SUNDAY		0			2.27	2.27
86-09-01	HOLIDAY		0			2.23	2.23
86-09-02	6200	6260	60	6.88	37.30	0.60	44.78
86-09-03	6260	6320	60	7.41	40.61	0.59	48.61
86-09-04	6320	6380	60	6.11	40.21	0.62	46.94
86-09-05	6380	6440	60	6.15	41.09	0.60	47.84
86-09-06	SATURDAY		0			2.36	2.36
86-09-07	SUNDAY		0			2.28	2.28
86-09-08	6440	6500	60	9.01	39.63	0.59	49.23
86-09-09	6500	6560	60	6.54	38.86	0.61	46.01
86-09-10	6560	6620	60	5.37	37.17	0.00	42.54
86-09-11	6620	6680	60	4.02	39.46	0.60	44.08
86-09-12	6680	6740	60	5.70	42.88	0.58	49.16
86-09-13	SATURDAY		0			2.29	2.29
86-09-14	SUNDAY		0			2.22	2.22
86-09-15	6740	6760	20	6.56	0.00	0.55	7.11
86-09-16	6760	6852	92	15.36	61.50	1.49	78.35
86-09-17	6852	6915	63	9.80	41.13	0.00	50.93
87-09-18	6915	6978	63	7.69	41.59	0.63	49.91
86-09-19	6978	7041	63	4.89	40.11	0.64	45.64
86-09-20	SATURDAY		0			2.41	2.41
86-09-21	SUNDAY		0			2.32	2.32
86-09-22	7041	7104	63	7.68	40.83	0.56	49.07
86-09-23	7104	7167	63	7.83	40.78	0.61	49.22
86-09-24	7167	7230	63	10.56	37.43	0.63	48.62
86-09-25	7230	7296	66	5.91	40.70	0.65	47.26
86-09-26	7296	7356	60	7.24	37.27	0.63	45.14
86-09-27	SATURDAY		0			3.82	3.82
86-09-28	SUNDAY		0			2.33	2.33
86-09-29	7356	7393	37	5.72	16.67	0.58	22.97
86-09-30	7393	7457	64	7.78	37.06	1.15	45.99
86-10-01	7457	7520	63	8.32	35.36	0.63	44.31
86-10-02	7520	7584	64	8.26	36.88	0.63	45.77
86-10-03	7584	7649	65	5.31	43.02	0.62	48.95
86-10-04	SATURDAY		0			2.37	2.37
86-10-05	SUNDAY		0			2.22	2.22
86-10-06	7649	7712	63	7.21	45.94	0.55	53.70
86-10-07	7712	7776	64	3.05	47.66	0.61	51.32
86-10-08	7776	7840	64	8.73	0.00	0.61	9.34
86-10-09	7840	7850	10	8.47	0.00	0.00	8.47
86-10-10	7850	7882	32	0.00	40.11	0.00	40.11
86-10-11	SATURDAY		0			2.32	2.32
86-10-12	SUNDAY		0			2.22	2.22
86-10-13	HOLIDAY		0			2.21	2.21
86-10-14	7882	7944	62	8.29	38.72	0.56	47.57
86-10-15	7944	8007	63	7.27	40.30	0.58	48.15

DATE	ODOMETER START	ODOMETER END	DISTA	OPPORTUN	BATTERY CHARGE OVER NIG	TRICK	TOTAL
86-10-16	8007	8070	63	8.29	37.13	0.58	46.00
86-10-17	8070	8102	32	7.33	21.42	0.58	29.33
86-10-18	SATURDAY		0			2.20	2.20
86-10-19	SUNDAY		0			2.15	2.15
86-10-20	8102	8132	30	0.00	27.52	0.61	28.13
86-10-21	8132	8205	73	0.00	41.26	1.39	
86-10-22	8205	8291	86	11.68	33.51	1.37	46.56
86-10-23	8291	8291	0	0.00	2.89	0.69	3.58
86-10-24	8291	8291	0	0.00	9.55	1.48	11.03
86-10-25	SATURDAY		0			2.96	2.96
86-10-26	SUNDAY		0			2.45	2.45
86-10-27	8291	8323	32	2.14	17.97	0.61	20.72
86-10-28	8323	8378	55	3.38	40.22	1.24	44.84
86-10-29	8378	8429	51	2.52	35.62	0.68	38.82
86-10-30	8429	8429	0	0.00	8.71	0.78	9.49
86-10-31	8429	8434	5	2.39	1.21	3.60	7.20
86-11-01	SATURDAY		0			3.23	3.23
86-11-02	SUNDAY		0			2.68	2.68
86-11-03	8434	8469	35	0.00	23.49	0.65	24.14
86-11-04	8469	8469	0	0.00		2.40	2.40
86-11-05	8469	8470	1	0.00	1.97	1.81	3.78
86-11-06	8470	8510	40	0.00	7.72	1.25	8.97
86-11-07	8510	8515	5	0.00	6.58	1.34	7.92
86-11-08	SATURDAY		0			2.57	2.57
86-11-09	SUNDAY		0			2.57	2.57
86-11-10	8515	8558	43	1.45	31.49	0.62	33.56
86-11-11	HOLIDAY		0			2.65	2.65
86-11-12	8558	8588	30	0.00	24.08	1.30	25.38
86-11-13	8588	8598	10	0.00	10.86	1.28	12.14
86-11-1?	8598	8599	1	0.00	0.00	3.28	3.28
86-11-15	SATURDAY		0			2.09	2.09
86-11-16	SUNDAY		0			2.19	2.19
86-11-17	8599	8662	63	9.35	36.73	0.57	46.65
86-11-18	8662	8725	63	9.27	39.02	0.59	48.88
86-11-19	8725	8788	63	9.84	41.86	0.59	52.29
86-11-20	8788	8852	64	8.45	33.65	0.58	42.68
86-11-21	8852	8914	62	8.72	35.45	0.58	44.75
86-11-22	SATURDAY		0			2.31	2.31
86-11-23	SUNDAY		0			2.26	2.26
86-11-24	8914	8976	62	4.67	44.28	0.57	49.52
86-11-25	8976	9037	61	7.98	34.88	0.58	43.44
86-11-26	9037	9098	61	7.36	39.23	0.60	47.19
86-11-27	9098	9160	62	7.25	42.02	0.59	49.86
86-11-28	9160	9221	61	7.06	40.89	0.60	48.55
86-11-29	SATURDAY		0			2.35	2.35
86-11-30	SUNDAY		0			2.37	2.37
86-12-01	9221	9282	61	7.56	43.21	0.55	51.32
86-12-02	9282	9346	64	4.72	43.35	0.63	48.70
86-12-03	9346	9407	61	6.20	40.77	0.60	47.57
86-12-04	9407	9465	58	8.27	39.23	0.60	48.10
86-12-05	9465	9528	63	7.05	42.06	0.61	49.72
86-12-06	SATURDAY		0			2.49	2.49
86-12-07	SUNDAY		0			2.36	2.36

DATE	ODOMETER START	ODOMETER END	DISTA	BATTERY CHARGE OPPORTUN	OVER NIG	TRICK	TOTAL
86-12-08	9528	9588	60			0.58	0.58
86-12-09	9588	9598	10			0.00	0.00
86-12-10	9598	9600	2			0.00	0.00
86-12-11	9600	9601	1			0.00	0.00
86-12-12	9601	9603	2			0.00	0.00
86-12-13	SATURDAY		0			0.00	0.00
86-12-14	SUNDAY		0			0.00	0.00
86-12-15	9603	9603	0			0.00	0.00
86-12-16	9603	9612	9			0.00	0.00
86-12-17	9612	9656	44			0.00	0.00
86-12-18	9656	9659	3			0.00	0.00
86-12-19	9659	9659	0			0.00	0.00
86-12-20	SATURDAY		0			0.00	0.00
86-12-21	SUNDAY		0			0.00	0.00
86-12-22	9659	9679	20			0.00	0.00
86-12-23	9679	9706	27			0.00	0.00
86-12-24	9706	9717	11		15.69	0.00	15.69
86-12-25	X'MAS		0			2.56	2.56
86-12-26	HOLIDAY		0			2.61	2.61
86-12-27	SATURDAY		0			2.58	2.58
86-12-28	SUNDAY		0			2.56	2.56
86-12-29	9717	9727	10	10.63		0.00	10.63
86-12-30	9727	9730	3	4.76		0.00	4.76
86-12-31	9730	9730	0	3.07		0.00	3.07
87-01-01	NEW YEAR		0			0.00	0.00
87-01-02	9730	9732	2	3.18		0.00	3.18
87-01-03	SATURDAY		0			0.00	0.00
87-01-04	SUNDAY		0			0.00	0.00
87-01-05	9732	9732	0			0.00	0.00
87-01-06	9732	9734	2	5.26		0.00	5.26
87-01-07	9734	9734	0			0.00	0.00
87-01-08	9734	9734	0			0.00	0.00
87-01-09	9734	9735	1			0.00	0.00
87-01-10	SATURDAY		0			0.00	0.00
87-01-11	SATURDAY		0			0.00	0.00
87-01-12	9735	9735	0			0.00	0.00
87-01-13	9735	9735	0			0.00	0.00
87-01-14	9735	9735	0			0.00	0.00
87-01-15	9735	9735	0			3.42	3.42
87-01-16	9735	9738	3			2.48	2.48
87-01-17	SATURDAY		0			2.56	2.56
87-01-18	SUNDAY		0			2.48	2.48
87-01-19	9738	9802	64	10.28	40.90	1.27	52.45
87-01-20	9802	9804	2	3.33	0.00	1.91	5.24
87-01-21	9804	9804	0			2.48	2.48
87-01-22	9804	9866	62	11.66	44.34	0.67	56.67
87-01-23	9866	9866	0	9.32		0.68	10.00
87-01-24	SATURDAY		0			0.00	0.00
87-01-25	SUNDAY		0			0.00	0.00
87-01-26	9866	9897	31	11.79	43.31	0.00	55.10
87-01-27	9897	9897	0			1.94	1.94
87-01-28	9897	9897	0			3.38	3.38
87-01-29	9897	9907	10	1.56	0.00	2.49	4.05

DATE	ODOMETER START	ODOMETER END	DISTA	OPPORTUN	OVER NIG	BATTERY CHARGE TRICK	TOTAL
87-01-30	9907	9907	0			2.50	2.50
87-01-31	SATURDAY		0			2.55	2.55
87-02-01	SUNDAY		0			2.54	2.54
87-02-02	9907	9907	0			2.47	2.47
87-02-03	9907	9941	34	3.59	0.00	1.86	5.45
87-02-04	9941	9970	29	0.00	22.36	1.26	23.62
87-02-05	9970	9997	27	0.00	28.49	0.63	0.00
87-02-06	9997	10018	21	0.00	17.70	1.31	19.01
87-02-07	SATURDAY		0			2.64	2.64
87-02-08	SUNDAY		0			2.65	2.65
87-02-09	10018	10039	21	5.54	16.88	1.34	23.76
87-02-10	10039	10082	43	5.74	31.65	1.28	38.67
87-02-11	10082	10125	43	9.37	27.41	0.86	37.64
87-02-12	10125	10188	63	9.39	46.27	1.38	57.04
87-02-13	10188	10245	57	9.68	50.72	0.71	61.11
87-02-14	SATURDAY		0			2.16	2.16
87-02-15	SUNDAY		0			2.74	2.74
87-02-16	10245	10312	67	6.24	42.85	1.32	50.41
87-02-17	10312	10376	64	9.18	43.39	2.61	55.18
87-02-18	10376	10439	63	11.82	41.99	0.88	54.69
87-02-19	10439	10501	62	7.75	42.53	0.99	51.27
87-02-20	10501	10562	61	9.36	41.19	0.97	51.52
87-02-21	SATURDAY		0			3.36	3.36
87-02-22	SUNDAY		0			3.22	3.22
87-02-23	10562	10622	60	7.95	0.00	0.87	8.82
87-02-24	10622	10632	10	9.42	47.70	0.00	57.12
87-02-25	10632	10632	0			3.24	3.24
87-02-26	10632	10693	61	9.93	41.79	1.50	53.22
87-02-27	10693	10753	60	8.11	42.91	1.04	52.06
87-02-28	SATURDAY		0			3.56	3.56
87-03-01	SUNDAY		0			3.64	3.64
87-03-02	10753	10815	62	11.61	43.37	1.00	55.98
87-03-03	10815	10876	61	10.63	43.30	1.06	54.99
87-03-04	10876	10939	63	7.61	40.28	1.04	48.93
87-03-05	10939	11001	62	10.63	43.27	1.22	55.12
87-03-06	11001	11067	66	9.37	46.79	1.03	57.19
87-03-07	SATURDAY		0			3.28	3.28
87-03-08	SUNDAY		0			3.92	3.92
87-03-09	11067	11129	62	11.47	44.50	0.99	56.96
87-03-10	11129	11191	62	11.49	39.69	0.90	52.08
87-03-11	11191	11253	62	11.84	39.43	0.96	52.23
87-03-12	11253	11315	62	10.46	39.40	0.96	50.82
87-03-13	11315	11376	61	9.74	40.44	1.16	51.34
87-03-14	SATURDAY		0			3.79	3.79
87-03-15	SUNDAY		0			3.36	3.36
87-03-16	11376	11438	62	13.67	35.60	0.91	50.18
87-03-17	11438	11500	62	14.23	31.74	1.12	47.09
87-03-18	11500	11563	63	11.78	38.46	1.08	51.32
87-03-19	11563	11626	63	14.81	34.77	1.34	50.92
87-03-20	11626	11689	63	7.44	42.42	1.02	50.88
87-03-21	SATURDAY		0			3.94	3.94
87-03-22	SUNDAY		0			5.94	5.94
87-03-23	11689	11689	0			1.32	1.32

DATE	ODOMETER START	ODOMETER END	DISTA	BATTERY CHARGE OPPORTUN	OVER NIG	TRICK	TOTAL
87-03-24	11689	11694	5	7.86	0.00	0.86	8.72
87-03-25	11694	11755	61	8.98	43.21	0.88	53.07
87-03-26	11755	11800	45	0.00	30.79	0.91	31.70
87-03-27	11800	11863	63	13.94	31.46	0.97	46.37
87-03-28	SATURDAY		0			3.26	3.26
87-03-29	SUNDAY		0			3.23	3.23
87-03-30	11863	11927	64	14.57	30.55	0.86	45.98
87-03-31	11927	11947	20	0.00	21.47	1.70	23.17
87-04-01	11947	11949	2	0.00	5.39	1.43	6.82
87-04-02	11949	11991	42	11.74	26.97	0.99	39.70
87-04-03	11991	12035	44	11.55	16.93	0.96	29.44
87-04-04	SATURDAY		0			3.74	3.74
87-04-05	SUNDAY		0			3.02	3.02
87-04-06	12035	12099	64	13.31	31.81	0.82	45.94
87-04-07	12099	12165	66	13.11	35.29	0.91	49.31
87-04-08	12165	12228	63	15.31	32.12	0.91	48.34
87-04-09	12228	12293	65	15.73	31.72	0.92	48.37
87-04-10	12292	12356	64	16.76	30.41	0.96	48.13
87-04-11	SATURDAY		0			3.42	3.42
87-04-12	SUNDAY		0			3.21	3.21
87-04-13	12356	12419	63	18.10	29.05	0.89	48.04
87-04-14	12419	12482	63	19.16	24.81	1.00	44.97
87-04-15	12482	12546	64	14.19	33.90	0.90	48.99
87-04-16	12546	12609	63	15.24	31.80	0.95	47.99
87-04-17	HOLIDAY		0			2.87	2.87
87-04-18	SATURDAY		0			2.72	2.72
87-04-19	SUNDAY		0			2.79	2.79
87-04-20	HOLIDAY		0			2.70	2.70
87-04-21	12609	12671	62	15.89	28.66	0.66	45.21
87-04-22	12671	12734	63	16.03	27.71	0.72	44.46
87-04-23	12734	12797	63	12.53	33.02	0.73	46.28
87-04-24	12797	12862	65	17.43	32.59	0.73	50.75
87-04-25	SATURDAY		0			2.64	2.64
87-04-26	SUNDAY		0			2.57	2.57
87-04-27	12862	12925	63	13.64	33.81	0.67	48.12
87-04-28	12925	12988	63	16.37	30.75	0.68	47.80
87-04-29	12988	13052	64	16.60	33.72	0.68	51.00
87-04-30	13052	13116	64	15.94	34.77	0.66	51.37
87-05-01	13116	13180	64	16.92	29.02	0.68	46.62
87-05-02	SATURDAY		0			2.69	2.69
87-05-03	SUNDAY		0			2.58	2.58
87-05-04	13180	13243	63	18.30	28.44	0.68	47.42
87-05-05	13243	13307	64	17.61	26.99	0.70	45.30
87-05-06	13307	13371	64	13.72	27.83	1.68	43.23
87-05-07	13371	13432	61	14.88	30.23	0.74	45.85
87-05-08	13432	13496	64	16.60	26.40	0.71	43.71
87-05-09	SATURDAY		0			2.60	2.60
87-05-10	SUNDAY		0			2.58	2.58
87-05-11	13496	13559	63	17.61	25.77	0.60	43.98
87-05-12	13559	13622	63	19.04	24.93	0.69	44.66
87-05-13	13622	13685	63	18.78	23.15	0.71	42.64

APPENDIX C

BATTERY DISCHARGE TEST RECORD

GM GRIFFON ELECTRIC VAN

CONTRACT ROUTINE MAINTENANCE - BATTERY TEST SHEET

* BATTERIES NOT WATERED PRIOR TO TEST!

OPERATOR MIN TRANSPORT & COMMS LOCATION TORONTO

* FV 616930

VEHICLE REGISTRATION NUMBER EV 11 MILEAGE 9659 MILES

BATTERY NUMBER B12620 DATE 12th June 1987

Time (min)	Start	5	15	30	60	End	
Battery Voltage	229	208	206	202	193	185	
Average Temp.	25	25	26	28	30	32	
Monobloc	s.g.		Links				Remarks
1	1300	5.67	33.7	5.70	5.44	5.16	
2	1260	5.86	11.4	5.70	5.45	5.24	
3	1290	5.90	11.4	5.73	5.47	5.25	
4	1305	5.93	11.5	5.76	5.51	5.21	
5	1305	5.89	11.4	5.72	5.47	5.25	
6	1310	5.95	11.3	5.77	5.52	5.32	
7	1305	5.90	22.0	5.72	5.46	5.23	*
8	1305	5.89	11.3	5.72	5.46	5.25	
9	1290	5.90	11.5	5.72	5.47	5.27	
10	1295	5.86	11.1	5.69	5.42	5.16	
11	1260	5.88	12.0	5.72	5.48	5.27	
12	1305	5.92	11.2	5.74	5.48	5.25	
13	1305	5.90	24.0	5.73	5.49	5.28	*
14	1310	5.93	11.4	5.76	5.54	5.27	
15	1310	5.91	11.7	5.73	5.49	5.28	
16	1300	5.93	11.6	5.75	5.51	5.32	
17	1300	5.91	11.6	5.73	5.48	5.24	
18	1295	5.89	11.3	5.71	5.46	5.23	
19	1295	5.88	11.5	5.71	5.45	5.20	
20	1290	5.89	13.0	5.72	5.47	5.24	
21	1300	5.88	11.4	5.70	5.44	5.20	
22	1260	5.86	11.4	5.70	5.44	5.22	
23	1300	5.92	11.2	5.75	5.51	5.32	
24	1300	5.90	29	5.72	5.47	5.26	*
25	1295	5.89	11.6	5.72	5.45	5.23	
26	1300	5.92	11.6	5.73	5.50	5.31	
27	1300	5.91	11.6	5.74	5.49	5.31	
28	1300	5.91	13.2	5.74	5.50	5.31	
29	1295	5.85	11.7	5.68	5.41	5.20	
30	1305	5.89	11.6	5.72	5.47	5.26	
31	1305	5.91	11.2	5.71	5.44	5.16	
32	1300	5.90	11.1	5.73	5.48	5.28	
33	1305	5.92	11.1	5.73	5.47	5.25	
34	1305	5.89	11.5	5.72	5.47	5.28	
35	1305	5.89	11.2	5.72	5.47	5.25	
36	1300	5.91	31.9	5.73	5.48	5.29	

LENGTH OF DISCHARGE 1 HR 22 MINS

AMPERE HOUR METER READING 122.7

GM GRIFFON ELECTRIC VAN

CONTRACT ROUTINE MAINTENANCE - BATTERY TEST SHEET

OPERATOR MINISTRY OF TRANS & COMMS LOCATION TORONTO

* FV 616917
VEHICLE REGISTRATION NUMBER EV 12 MILEAGE 9736

BATTERY NUMBER B 12610 DATE 13/1/87

Time (min)	Start	5	15	30	60	End	
Battery Voltage	208	199	201	198	190	185	
Average Temp.	23	23	24	25	27	28	
Monobloc	s.g.		Links				Remarks
1	1260	5.76	329	5.61	5.38	5.24	
2	1275	5.79	116	5.63	5.42	5.30	
3	1275	5.78	11.2	5.62	5.40	5.27	
4	1285	5.82	12.8	5.66	5.44	5.23	
5	1295	5.80	10.7	5.64	5.42	5.31	
6	1280	5.77	11.2	5.62	5.38	5.25	
7	1290	5.81	21.6	5.64	5.43	5.32	X
8	1270	5.75	12.2	5.59	5.35	5.23	
9	1270	5.79	12.8	5.62	5.40	5.29	
10	1265	5.76	13.4	5.59	5.36	5.24	
11	1295	5.82	11.5	5.66	5.42	5.34	
12	1280	5.76	12.5	5.57	5.29	5.10	
13	1270	5.76	23.9	5.61	5.39	5.29	X
14	1290	5.78	12.4	5.60	5.36	5.23	
15	1270	5.73	10.9	5.61	5.40	5.29	
16	1295	5.79	11.6	5.64	5.43	5.32	
17	1290	5.80	12.6	5.64	5.44	5.35	
18	1295	5.78	12.0	5.61	5.39	5.27	
19	1270	5.75	12.1	5.59	5.36	5.23	
20	1290	5.75	13.4	5.59	5.34	5.19	
21	1290	5.82	12.9	5.65	5.45	5.35	
22	1290	5.77	10.7	5.61	5.39	5.27	
23	1300	5.82	17.0	5.64	5.41	5.29	
24	1265	5.76	23.0	5.60	5.34	5.26	X
25	1275	5.73	11.6	5.56	5.30	5.13	
26	1290	5.78	10.9	5.60	5.36	5.26	
27	1270	5.74	11.2	5.58	5.35	5.23	
28	1295	5.79	11.5	5.61	5.39	5.27	
29	1290	5.76	12.5	5.61	5.40	5.29	
30	1295	5.81	12.0	5.63	5.41	5.30	
31	1275	6.74	10.9	5.58	5.33	5.18	
32	1290	5.80	12.0	5.63	5.41	5.30	
33	1295	5.78	11.4	5.61	5.39	5.25	
34	1295	5.82	11.3	5.64	5.42	5.30	
35	1270	5.75	11.8	5.59	5.35	5.23	
36	1295	5.79	32.1	5.63	5.40	5.26	

LENGTH OF DISCHARGE - 1 HOUR 20 MINS
AMP/HOUR METER READING - 1188

APPENDIX D

DAILY TEMPERATURE RECORD

TEMPERATURE

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
86-05-14	15.7	10.9	13.3
86-05-15	20.5	15.2	17.9
86-05-16	21.7	17.8	19.8
86-05-17	25.7	19.6	22.7
86-05-18	25.9	19.2	22.6
86-05-19	12.6	11.5	12.1
86-05-20	11.9	10.9	11.4
86-05-21	14.5	12.0	13.3
86-05-22	16.7	11.7	14.2
86-05-23	15.8	12.6	14.2
86-05-24	20.9	14.9	17.9
86-05-25	24.9	17.2	21.1
86-05-26	25.2	18.8	22.0
86-05-27	23.6	17.7	20.7
86-05-28	27.6	20.3	24.0
86-05-29	28.7	21.7	25.2
86-05-30	29.0	23.1	26.1
86-05-31	23.0	17.4	20.2
86-06-01	27.1	17.1	22.1
86-06-02	14.1	9.2	11.7
86-06-03	17.6	9.9	13.8
86-06-04	27.0	16.4	21.7
86-06-05	17.4	13.9	15.7
86-06-06	17.6	14.7	16.2
86-06-07	21.6	17.9	19.8
86-06-08	23.9	17.2	20.6
86-06-09	23.1	15.4	19.3
86-06-10	23.7	15.0	19.4
86-06-11	20.0	17.0	18.5
86-06-12	17.0	15.3	16.2
86-06-13	22.2	15.8	19.0
86-06-14	23.1	16.2	19.7
86-06-15	20.0	16.5	18.3
86-06-16	27.9	19.2	23.6
86-06-17	17.9	12.1	15.0
86-06-18	21.3	13.7	17.5
86-06-19	22.5	17.0	19.8
86-06-20	23.7	17.5	20.6
86-06-21	24.6	16.8	20.7
86-06-22	31.7	22.2	27.0
86-06-23	26.6	20.7	23.7
86-06-24	18.7	13.1	15.9
86-06-25	20.2	13.5	16.9

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
86-06-26	25.0	19.3	22.2
86-06-27	25.0	21.8	23.4
86-06-28	27.8	21.8	24.8
86-06-29	25.9	18.9	22.4
86-06-30	22.6	16.2	19.4
86-07-01	22.7	15.3	19.0
86-07-02	24.3	18.9	21.6
86-07-03	19.6	15.3	17.5
86-07-04	25.2	17.7	21.5
86-07-05	30.8	25.3	28.1
86-07-06	34.3	27.3	30.8
86-07-07	30.4	23.9	27.2
86-07-08	28.3	22.7	25.5
86-07-09	26.2	19.8	23.0
86-07-10	24.5	18.1	21.3
86-07-11	20.5	15.6	18.1
86-07-12	17.9	15.9	16.9
86-07-13	27.6	21.3	24.5
86-07-14	25.5	19.9	22.7
86-07-15	27.9	20.0	24.0
86-07-16	25.6	21.1	23.4
86-07-17	26.7	21.5	24.1
86-07-18	30.1	25.5	27.8
86-07-19	26.6	23.2	24.9
86-07-20	29.5	23.6	26.6
86-07-21	23.1	18.1	20.6
86-07-22	25.2	18.3	21.8
86-07-23	29.3	22.5	25.9
86-07-24	31.2	23.5	27.4
86-07-25	30.3	24.5	27.4
86-07-26	25.2	22.5	23.9
86-07-27	26.3	22.4	24.4
86-07-28	27.7	22.5	25.1
86-07-29	25.7	22.0	23.9
86-07-30	25.5	22.0	23.8
86-07-31	25.8	22.1	24.0
86-08-01	26.6	21.4	24.0
86-08-02	26.9	20.5	23.7
86-08-03	24.2	18.4	21.3
86-08-04	25.6	18.4	22.0
86-08-05	27.3	20.9	24.1
86-08-06	26.7	21.6	24.2
86-08-07	21.6	19.9	20.8
86-08-08	25.6	20.7	23.2
86-08-09	26.2	21.1	23.7
86-08-10	24.8	19.9	22.4
86-08-11	21.2	15.5	18.4
86-08-12	23.3	16.2	19.8
86-08-13	23.8	16.2	20.0
86-08-14	25.0	18.4	21.7
86-08-15	29.6	24.5	27.1
86-08-16	28.7	23.4	26.1
86-08-17	29.4	22.7	26.1

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
86-08-18	27.3	21.3	24.3
86-08-19	25.1	18.8	22.0
86-08-20	26.1	19.2	22.7
86-08-21	26.4	21.2	23.8
86-08-22	20.8	16.1	18.5
86-08-23	23.7	18.8	21.3
86-08-24	21.2	15.5	18.4
86-08-25	23.4	15.9	19.7
86-08-26	26.4	20.0	23.2
86-08-27	19.4	13.5	16.5
86-08-28	16.3	10.2	13.3
86-08-29	19.9	12.4	16.2
86-08-30	22.4	14.6	18.5
86-08-31	22.3	14.5	18.4
86-09-01	23.8	15.6	19.7
86-09-02	25.3	17.9	21.6
86-09-03	23.1	19.3	21.2
86-09-04	25.3	21.1	23.2
86-09-05	23.2	17.5	20.4
86-09-06	18.4	13.4	15.9
86-09-07	15.8	10.0	12.9
86-09-08	19.3	11.0	15.2
86-09-09	22.2	15.0	18.6
86-09-10	19.5	16.4	18.0
86-09-11	23.3	20.6	22.0
86-09-12	19.9	14.1	17.0
86-09-13	20.5	13.4	17.0
86-09-14	16.8	9.7	13.3
86-09-15	10.6	6.8	8.7
86-09-16	12.8	7.6	10.2
86-09-17	14.5	8.5	11.5
86-09-18	17.8	12.6	15.2
86-09-19	18.8	15.8	17.3
86-09-20	15.7	14.0	14.9
86-09-21	17.4	14.3	15.9
86-09-22	15.1	13.1	14.1
86-09-23	22.6	17.8	20.2
86-09-24	24.1	17.3	20.7
86-09-25	19.2	14.4	16.8
86-09-26	21.5	18.2	19.9
86-09-27	16.2	14.2	15.2
86-09-28	17.0	14.9	16.0
86-09-29	23.7	19.4	21.6
86-09-30	22.0	17.7	19.9
86-10-01	18.9	15.1	17.0
86-10-02	20.1	15.7	17.9
86-10-03	18.3	14.7	16.5
86-10-04	14.3	11.5	12.9
86-10-05	15.1	10.7	12.9
86-10-06	10.1	6.4	8.3
86-10-07	15.3	8.9	12.1
86-10-08	17.3	12.3	14.8
86-10-09	10.2	4.9	7.6

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
86-10-10	7.2	2.8	5.0
86-10-11	13.2	5.7	9.5
86-10-12	15.0	10.4	12.7
86-10-13	18.7	15.5	17.1
86-10-14	14.2	9.2	11.7
86-10-15	11.4	6.4	8.9
86-10-16	9.9	6.0	8.0
86-10-17	8.7	4.6	6.6
86-10-18	11.5	4.8	8.2
86-10-19	15.4	6.8	11.1
86-10-20	17.7	9.7	13.7
86-10-21	17.7	11.9	14.8
86-10-22	20.4	12.8	16.6
86-10-23	16.5	8.9	12.7
86-10-24	11.8	6.0	8.9
86-10-25	10.6	4.8	7.7
86-10-26	11.2	9.0	10.1
86-10-27	12.9	9.8	11.4
86-10-28	16.0	10.1	13.1
86-10-29	15.2	10.3	12.8
86-10-30	6.8	2.0	4.4
86-10-31	9.2	2.4	5.8
86-11-01	18.8	12.1	15.5
86-11-02	8.3	3.4	5.9
86-11-03	9.2	3.4	6.3
86-11-04	6.6	0.5	3.6
86-11-05	6.3	0.8	3.6
86-11-06	12.5	8.0	10.3
86-11-07	9.8	4.7	7.3
86-11-08	15.7	10.2	13.0
86-11-09	11.8	5.6	8.7
86-11-10	4.8	1.4	3.1
86-11-11	4.2	0.8	2.5
86-11-12	5.1	0.3	2.7
86-11-13	-3.9	-6.8	-5.4
86-11-14	0.6	-4.8	-2.1
86-11-15	3.2	1.6	2.4
86-11-16	4.5	2.0	3.3
86-11-17	10.1	4.4	7.3
86-11-18	2.4	-1.2	0.6
86-11-19	-2.2	-6.5	-4.4
86-11-20	0.0	-1.7	-0.9
86-11-21	0.6	-2.8	-1.1
86-11-22	3.8	-1.6	1.1
86-11-23	7.3	0.9	4.1
86-11-24	5.8	3.4	4.6
86-11-25	7.4	2.5	5.0
86-11-26	5.1	2.2	3.7
86-11-27	7.2	3.9	5.6
86-11-28	5.0	3.0	4.0
86-11-29	7.7	2.2	5.0
86-11-30	-1.5	-4.3	-2.9
86-12-01	1.8	-3.1	-0.7

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
86-12-02	2.8	0.8	1.8
86-12-03	3.9	1.4	2.7
86-12-04	1.4	-1.0	0.2
86-12-05	1.7	-1.3	0.2
86-12-06	1.6	-2.4	-0.4
86-12-07	2.1	-3.0	-0.4
86-12-08	-0.4	-5.8	-3.1
86-12-09	1.9	-4.2	-1.2
86-12-10	1.6	-2.4	-0.4
86-12-11	-1.3	-4.1	-2.7
86-12-12	-0.6	-6.4	-3.5
86-12-13	-4.9	-10.8	-7.9
86-12-14	2.5	-4.3	-0.9
86-12-15	2.6	1.3	2.0
86-12-16	2.0	1.1	1.6
86-12-17	3.9	2.0	3.0
86-12-18	3.2	2.0	2.6
86-12-19	2.2	1.0	1.6
86-12-20	2.0	0.0	1.0
86-12-21	0.9	-2.8	-1.0
86-12-22	2.3	-1.7	0.3
86-12-23	3.2	1.3	2.3
86-12-24	3.2	2.0	2.6
86-12-25	3.4	2.1	2.8
86-12-26	2.5	1.3	1.9
86-12-27	1.2	0.2	0.7
86-12-28	2.1	0.4	1.3
86-12-29	1.7	0.2	1.0
86-12-30	1.1	-0.4	0.4
86-12-31	1.9	0.3	1.1
87-01-01	1.7	0.4	1.1
87-01-02	-0.7	-2.2	-1.5
87-01-03	-1.2	-5.0	-3.1
87-01-04	0.6	-5.9	-2.7
87-01-05	3.8	-2.3	0.8
87-01-06	3.3	-0.3	1.5
87-01-07	3.7	0.3	2.0
87-01-08	-0.4	-2.9	-1.7
87-01-09	0.1	-0.6	-0.3
87-01-10	0.9	-0.3	0.3
87-01-11	0.1	-1.6	-0.8
87-01-12	2.4	1.0	1.7
87-01-13	3.9	1.0	2.5
87-01-14	5.9	2.3	4.1
87-01-15	3.6	0.3	2.0
87-01-16	-2.5	-6.1	-4.3
87-01-17	-3.0	-7.3	-5.2
87-01-18	-0.1	-2.6	-1.4
87-01-19	-3.8	-8.9	-6.4
87-01-20	-2.3	-11.5	-6.9
87-01-21	-3.5	-5.9	-4.7
87-02-24	0.3	-4.3	-2.0
87-01-22	-1.2	-4.2	-2.7

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
87-01-24	-11.7	-14.5	-13.1
87-01-25	-6.6	-11.5	-9.1
87-01-26	-9.2	-13.2	-11.2
87-01-27	-4.7	-11.0	-7.9
87-01-28	-3.0	-8.6	-5.8
87-01-29	-0.9	-4.1	-2.5
87-01-30	1.2	-1.1	0.0
87-01-31	-3.2	-6.7	-5.0
87-02-01	2.6	-3.8	-0.6
87-02-02	2.4	0.2	1.3
87-02-03	3.6	1.2	2.4
87-02-04	0.0	-5.8	-2.9
87-02-05	-1.0	-6.6	-3.8
87-02-06	3.5	-2.2	0.6
87-02-07	4.2	1.7	3.0
87-02-08	3.2	-5.8	-1.3
87-02-09	-4.5	-11.0	-7.8
87-02-10	0.5	-4.1	-1.8
87-02-11	-1.0	-5.0	-3.0
87-02-12	0.4	-4.9	-2.3
87-02-13	-9.9	-13.4	-11.7
87-02-14	-13.1	-16.7	-14.9
87-02-15	-13.5	-18.7	-16.1
87-02-16	-9.8	-15.5	-12.7
87-02-17	-3.1	-9.6	-6.4
87-02-18	-3.0	-7.1	-5.1
87-02-19	0.5	-6.4	-3.0
87-02-20	2.0	-5.3	-1.7
87-02-21	3.4	-4.1	-0.3
87-02-22	3.1	-2.4	0.4
87-02-23	2.6	-1.0	0.8
87-02-25	1.0	-4.8	-1.9
87-02-26	1.2	-4.1	-1.5
87-02-27	3.0	-2.8	0.1
87-02-28	1.7	0.5	1.1
87-03-01	4.1	2.6	3.4
87-03-02	3.5	-0.1	1.7
87-03-03	-1.4	-4.7	-3.1
87-03-04	0.5	-4.4	-2.0
87-03-05	2.2	-1.8	0.2
87-03-06	11.9	3.6	7.8
87-03-07	16.7	9.7	13.2
87-03-08	18.2	9.6	13.9
87-03-09	2.5	-5.0	-1.3
87-03-10	-5.0	-10.1	-7.6
87-03-11	-1.4	-7.1	-4.3
87-03-12	3.5	-1.7	0.9
87-03-13	2.6	-2.3	0.2
87-03-14	3.0	-2.6	0.2
87-03-15	5.1	-1.4	1.8
87-03-16	4.8	-1.6	1.6
87-03-17	7.9	1.0	4.5
87-03-18	9.1	1.3	5.2
87-03-19	11.0	3.0	7.0

	DAILY MAXIMUM	DAILY MEAN	BATTERY AMBIENT
87-03-20	9.6	3.1	6.4
87-03-21	11.1	4.0	7.6
87-03-22	12.8	6.7	9.8
87-03-23	14.9	7.2	11.1
87-03-24	17.4	8.0	12.7
87-03-25	13.3	7.6	10.5
87-03-26	9.8	7.2	8.5
87-03-27	10.4	7.2	8.8
87-03-28	14.1	8.3	11.2
87-03-29	15.2	8.5	11.9
87-03-30	9.5	3.6	6.6
87-03-31	-2.0	-4.3	-3.2
87-04-01	1.5	-2.5	-0.5
87-04-02	3.5	0.9	2.2
87-04-03	3.2	-0.7	1.3
87-04-04	7.8	3.3	5.6
87-04-05	9.4	7.9	8.7
87-04-06	12.6	9.8	11.2
87-04-07	14.8	8.8	11.8
87-04-08	12.3	6.7	9.5
87-04-09	16.6	8.1	12.4
87-04-10	21.8	13.1	17.5
87-04-11	17.6	10.8	14.2
87-04-12	10.0	7.2	8.6
87-04-13	14.2	9.3	11.8
87-04-14	16.5	10.6	13.6
87-04-15	15.4	12.4	13.9
87-04-16	14.5	10.8	12.7
87-04-17	15.9	11.9	13.9
87-04-18	18.8	12.5	15.7
87-04-19	23.3	15.3	19.3
87-04-20	23.5	17.2	20.4
87-04-21	28.8	18.3	23.6
87-04-22	12.1	9.3	10.7
87-04-23	16.0	11.7	13.9
87-04-24	13.0	6.7	9.9
87-04-25	12.7	5.9	9.3
87-04-26	15.0	9.0	12.0
87-04-27	15.1	7.7	11.4
87-04-28	9.6	5.4	7.5
87-04-29	18.5	9.8	14.2
87-04-30	10.9	6.1	8.5
87-05-01	16.2	8.0	12.1
87-05-02	15.5	8.1	11.8
87-05-03	13.3	6.9	10.1
87-05-04	12.5	5.6	9.1
87-05-05	18.9	9.5	14.2
87-05-06	23.6	13.2	18.4
87-05-07	16.5	9.3	12.9
87-05-08	19.3	9.4	14.4
87-05-09	28.3	18.1	23.2
87-05-10	24.3	19.2	21.8
87-05-11	19.6	20.0	24.8
87-05-12	15.4	9.6	12.5
87-05-13	18.5	9.7	14.1

APPENDIX E

BATTERY WATERING RECORD

Battery Water Topping up Record
First Year Courier Service
EV 11

DATE	Mileage mile	LHS litre	RHS litre	TOTAL litre
86-05-21	1371	2.4	3.0	5.4
86-06-02	1827	3.0	2.8	11.2
86-06-18	2503	2.8	3.0	17.0
86-07-04	3136	5.3	5.7	28.0
86-07-14	3536	3.7	3.3	35.0
86-07-28	4085	0	3.7	38.7
86-07-31	4271	1.6	0.6	40.9
86-08-07	4487	5.2	2.0	48.1
86-08-22	5169	3.8	3.8	55.7
86-09-05	5735	5.1	5.5	66.3
86-09-19	6255	3.5	3.6	73.4
86-10-02	6760	5.2	4.5	83.1
86-10-16	7170	3.9	4.2	91.2
86-10-29	7648	3.1	2.5	96.8
86-11-17	8268	4.0	4.8	105.6
86-11-25	8308	2.9	2.7	111.2
86-12-10	8653	2.8	2.6	116.6
87-01-02	9354	3.8	4.5	124.9
87-01-14	9660	3.0	6.0	133.9
87-02-12	10582	2.2	9.2	145.3
87-02-26	11089	0	4.0	149.3
87-03-04	11290	4.0	6.0	159.3
87-03-10	11473	0.9	2.8	163.0
87-03-26	12046	0.8	1.0	164.8
87-04-13	12464	1.4	1.4	167.6
87-04-28	13003	1.8	1.9	171.3
87-05-13	13692	2.3	2.6	176.2

Battery Water Topping up Record
First Year Courier Service
EV 12

DATE	MILEAGE mile	LHS litre	RHS litre	TOTAL litre
86-05-22	2162	3.2	3.4	6.6
86-06-02	2597	4.0	4.0	14.6
86-06-18	3187	3.4	0	18.0
86-06-24	3428	2.0	5.2	25.2
86-07-09	3971	3.4	5.0	33.6
86-07-22	4504	3.6	2.0	39.2
86-08-07	5179	3.0	5.0	47.2
86-08-22	5838	8.9	6.7	62.8
86-09-05	6391	2.8	3.9	69.5
86-09-19	6981	2.2	2.6	74.3
86-10-02	7520	2.6	4.1	81.0
86-10-16	8008	3.3	2.4	87.7
86-10-29	8379	3.0	2.4	93.1
86-11-13	8588	3.6	2.4	99.1
86-11-26	9048	2.9	1.9	103.9
86-12-16	9599	3.1	2.4	109.4
87-01-02	9732	3.0	3.4	115.8
87-01-12	9736	0.5	0.0	116.3
87-02-03	9940	1.6	5.0	122.9
87-02-17	10333	2.6	1.9	127.4
87-03-05	10939	1.8	2.0	131.2
87-03-23	11690	4.5	3.3	139.0
87-04-07	12121	1.3	1.2	141.5
87-04-21	12629	1.5	2.9	145.9
87-05-06	13327	2.7	3.0	151.6